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COVER SHEET

Access 5 Project Deliverable

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Abstract:

This cover sheet is for version 2 of the weather requirements document along with Appendix A. The purpose of the requirements document was to identify and to list the weather functional requirements needed to achieve the Access 5 vision of “operating High Altitude, Long Endurance (HALE) Unmanned Aircraft Systems (UAS) routinely, safely, and reliably in the National Airspace System (NAS) for Step 1.” A discussion of the Federal Aviation Administration (FAA) references and related policies, procedures, and standards is provided as basis for the recommendations supported within this document. Additional procedures and reference documentation related to weather functional requirements is also provided for background. The functional requirements and related information are to be proposed to the FAA and various standards organizations for consideration and approval. The appendix was designed to show that sources of flight weather information are readily available to UAS pilots conducting missions in the NAS. All weather information for this presentation was obtained from the public internet.

Status:

| |
|---------------|
| SEIT-Approved |
| |

Limitations on use:

This document represents thoughts and ideas of the Weather Awareness work package team. It has not been reviewed or approved as an Access 5 project position on this subject. In addition to SEIT review and comment, the information also needs substantiation through simulation/flight demonstrations. Furthermore, this document is an interim deliverable. It represents the project position on Weather Awareness functions and performance requirements limited to enroute operations above FL430. Operations below FL430 and terminal operations have not been addressed in this document.



Weather Requirements and Procedures

(Update for FY05)

For

STEP 1

**High Altitude Long Endurance (HALE)
Unmanned Aircraft System (UAS)
Flight Operations in the National Air Space (NAS)**

By

WP09 Weather Work Package

The following document was prepared by a collaborative team through the noted work package. This was a funded effort under the Access 5 Project.



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EXECUTIVE SUMMARY

The purpose of this document is to identify and to list the weather functional requirements needed to achieve the Access 5 vision of “*operating High Altitude, Long Endurance (HALE) Unmanned Aircraft Systems (UAS) routinely, safely, and reliably in the National Airspace System (NAS) for Step 1.*” A discussion of the Federal Aviation Administration (FAA) references and related policies, procedures, and standards is also included. Additional procedures and reference documentation related to weather functional requirements is also provided for background. The functional requirements and related information are to be proposed to the FAA and various standards organizations for consideration and approval.

Additional information contained in this document relates to the availability and the limitations of weather data and products required for support to Step 1 operations. The need for routine weather information, both current and forecast, at Step 1 altitudes which are above FL430 is not new. Since the highest current use of the NAS occurs at altitudes below FL430, the availability of forecast weather data and products is limited above that flight level. Few forecast weather data and products are currently produced by the National Weather Service (NWS) National Meteorological Center (NMC) at or above FL450. This document identifies some of the limitations with obtaining weather information for the Step 1 mission profile.

**Access 5 High Altitude Long Endurance (HALE)
Unmanned Aircraft System (UAS)**
Weather Requirements and Procedures for STEP 1 Flight Operations

1. *General.* The Access 5 HALE UAS requires weather awareness requirements and procedures to perform Access 5 STEP 1 flight operations. All Access 5 STEP 1 flight operations begin when the UAS enters the airspace at altitudes at or above FL430. The Access 5 weather work package is responsible for producing requirements and procedures involving weather for STEP 1 UAS flight operations. This document provides weather requirements and procedures to be considered for application for Access 5 STEP 1 flight operations.
2. *Background.* The need for routine weather information, both current and forecast, at altitudes above FL430 is not new. However, based on the research completed for this requirements investigation, commercially available weather information for operating altitudes of FL450 and higher is limited. The limitations discovered during the investigation detailing the weather limiting factors for Access 5 HALE UAS STEP 1 operations are provided below.
 - a. Limitations on forecast weather data and products at or above FL450. Since the highest current use of the NAS occurs at altitudes below FL430, the use of forecast weather data and products is limited above that flight level. In addition, based on the investigation results at this time the National Weather Service (NWS) National Meteorological Center (NMC) has no requirement to produce forecast weather data and products above FL550, or atmospheric pressure levels above 100 millibars (mb) or hectopascals (hPa). Based on this investigation the limitations listed below exist for forecast weather data and products.
 - i. Forecast wind and temperature data are not normally available for FL450 and FL530, but are available on request/reply to users via AFSS/FSS.
 - ii. NOTE: There are specific flight level winds which NOAA, NWS, and NMC produce products for on a normal schedule. Data for FL420 through FL480 must be specially requested and are normally derived from the flight level closest to actual standard NWS forecast level.
 - iii. Forecast data and products for wind, temperature, and flight hazard (turbulence, and icing) information and products at operating altitudes at or above FL530. Based on the investigation completed this year, it is unclear whether or not the NWS produces flight hazard forecasts at or above FL530. The references reviewed do not list any data or products above FL530.
 - iv. NOTE: A high-level significant weather prognostic chart is produced for the entire layer from FL240 to FL600. However, these products provide average weather conditions for the entire FL240-to-FL600 layer, but do not provide information at specific altitudes in this layer.
 - b. Observed weather data and products at or above FL430. The NWS produces observational data for altitudes below, at, and above FL430. These observations are

primarily taken from the NWS rawinsonde network. Rawinsonde observations include temperature, wind, humidity, and several other meteorological parameters. The rawinsonde observations are taken at specified levels from station ground level up to approximately 100,000 feet. These data are available via the internet and specify data for designated rawinsonde sites located across the U.S.

3. *STEP 1 Limitations.* Since the Access 5 HALE UAS program is phased into 4 steps there are specific weather work package objectives to be addressed for each of these steps. The STEP 1 objectives are limited to weather support requirements for flight operations at or above FL430. This implies weather issues will be limited to addressing the following operational areas:
 - a. Safety of flight and Step 1 weather awareness at or above FL430
 - b. Maneuvering and routing at or above FL430
 - c. Mission planning at or above FL430
 - d. Solar Environmental Events affecting flight at or above FL430
 - e. Contingency Management for Solar Environmental Events affecting flight at or above FL430.
 - f. Weather requirements below FL430 are not part of, nor the responsibility of, the Access 5 STEP 1 program effort.
4. *STEP 1 Assumptions.* The requirements listed in this document provide a starting point for the evaluation of STEP 1 weather support and procedures. These requirements were produced using the following set of assumptions:
 - a. Unless specifically addressed under limiting factors (para. 5), weather data and products required for initial STEP 1 flight operations are available via the highest possible direct or internet communications connection speed from existing public or private Qualified Internet Commercial Provider (QICP) sources.
 - b. UAS pilot organizations supporting Access 5 flight operations have access to weather sources required for initial STEP 1 flight operations.
 - c. UAS pilots are required to satisfy the same FAA en route wind weather briefing information requirements levied on other non-UAS pilots.
 - d. The Access 5 Policy IPT will address with the appropriate agencies any limiting factors identified by this work package in the area of STEP 1 weather data and products.
 - e. The UAS pilot has as good or better access to flight weather information than pilots of manned aircraft.
5. *Step 1 Weather Functional Requirements.* The following weather functional requirements apply to Access 5 HALE UAS Step 1 operations. These requirements are extracted from the Functional Requirements Document for HALE UAS Operations in the NAS, Step 1, Version 2, dated September 2005.

5.4.3 AVOID HAZARDOUS WEATHER

The UAS shall be able to avoid hazardous weather while flying in the NAS. Hazardous weather is defined as any atmospheric or space environment phenomena that could be

detrimental to the UAS mission. Hazardous aviation weather for the purposes of Step 1 typically includes thunderstorms, icing conditions, turbulence, or massive solar ejections. However, this may vary based on the structural characteristics of the UA being flown. It is important to note that the primary need for the UAS avoiding hazardous weather is to prevent the UA from harming people or property, not for self preservation of the UA.

5.4.3.1 Maintain Weather Awareness

The UAS Weather Awareness System shall maintain awareness of hazardous weather along the entire route of flight. The UAS should be able to routinely access pertinent aviation weather information to include atmospheric and space weather data. This requirement ensures the UAS pilot has access to the necessary weather information resources such as ATC and/or packaged weather products, throughout the entire route of the flight.

5.4.3.1.1 Gather Weather Information

The UAS Weather Awareness System shall gather all necessary weather information for the entire route of flight. This information should be gathered for the altitude at which the UAS will be operating as well as the area below the UAS in case descent through the lower airspace is required. It is assumed that the UAS pilot is part of the UAS Weather Awareness System.

5.4.3.1.1.1 Request weather information (HSI F8b)

The UAS Human System Interface shall enable the pilot to request weather specific to a current or future flight plan.

5.4.3.1.1.2 Convey weather information to the UAS Pilot (HSI F8a)

The UAS Human System Interface shall convey weather information to the pilot.

5.4.3.1.2 Evaluate Potential for Weather Conflicts

The UAS Weather Awareness System shall evaluate the potential for flying into hazardous weather situations. This requirement enables the UAS pilot to plan for hazardous weather along the route of flight utilizing all available weather resources.

5.4.3.2 Coordinate Weather Avoidance Maneuver

The UAS Weather Awareness System shall coordinate with ATC the appropriate avoidance maneuver that prevents the UA from flying through the hazardous weather. The UA will always be flying under Instrument Flight Rules and, therefore must coordinate any deviation of the current flight path with ATC.

5.4.3.3 Command Weather Avoidance Maneuver

The UAS Weather Awareness System shall be capable of commanding an appropriate

maneuver to avoid the hazardous weather. It is assumed that the UAS pilot, as part of the UAS Weather Awareness System, will initiate the maneuver since autonomous maneuvers are outside the scope of Step 1. The commanded maneuver can include initiating a new maneuver, continuing an ongoing maneuver, or terminating an avoidance maneuver if hazardous weather no longer exists.

5.4.3.3.1 Control the Weather Awareness System (HSI F8c)

The UAS Human System Interface shall enable the pilot to control the Weather Awareness System. The pilot must have the ability to configure the Weather Awareness System settings as well as initiate, modify, or discontinue and avoidance maneuver.

6. ***Detailed weather requirements discussion.*** The following information provides background detail on the Step 1 Weather Functional Requirements. In addition, a separate section is included to highlight key procedural considerations related to the functional requirements.

a. ***STEP 1 Requirements.*** The process of identifying weather requirements for Access 5 HALE UAS flight operations will evolve over the life of the Access 5 program. This document provides an initial set of support requirements for areas expected to be part of STEP 1 flight operations. As the initial and follow-on simulation and flight test events take place and weather impacts are better known, this list of requirements will be refined and updated. These updates and refinements will lead to a set of requirements that reflect a more broad operational scope of weather support required for STEP 1 flight operations. The initial requirements are listed below.

- i. UAS pilots are required to have the appropriate pilot knowledge accessible to them with regard to Air Traffic order 7110.10R, Flight Services, with specific reference to Chapter 9, FAA Weather Services.

NOTE: FAA document, Advisory Circular (AC) 00-45E, December 1999 (revised), Aviation Weather Services, is the Air Traffic publication weather services reference in publication 7110.10R for detailed information weather services provided to FAA certified aircraft.

- ii. UAS pilots are required to have the appropriate pilot knowledge accessible to them with regard to Air Traffic Order 7210.3T, Facility Operation and Administration, with specific reference to Part 4, Chapter 14, Aviation Meteorological Services and Equipment.
- iii. UAS aircraft pilots can access the information on ATC Service A circuits, which may include but is not limited to, the Hazardous In-flight Weather Advisory Service (HIWAS), to receive updated weather information while operating UAS aircraft.
- iv. UAS aircraft pilots require the following atmospheric flight weather briefing information for weather awareness, mission planning, safety of flight,

contingency management and scheduled operations at or above FL430 for the entire route and duration of flight:

1. Pilot weather briefing information on current and forecast en route winds at the expected operating altitude at or above FL430
2. Pilot weather briefing information on current and forecast en route temperatures along the route at the expected operating altitude
3. Pilot weather briefing information on forecast flight hazards (turbulence or icing) of any intensity en route at the expected operating altitude at or above FL430
4. Pilot weather briefing information on forecast areas of en route thunderstorms.
5. Pilot considers all weather awareness information as appropriate to the mission, and proceeds per approval of the FAA during flight
6. Pilot has access to all QICP websites depicting appropriate tropospheric weather data useful to flight.
7. Pilot shall gather hazardous atmospheric weather information and take the appropriate actions to complete UAS mission planning preparations prior to flight.
8. Pilot shall access and update mission planning information as necessary from all QICP sources to ensure appropriate route changes are completed to avoid new or developing hazardous tropospheric weather conditions.
9. When a contingency occurs, the pilot shall access and update contingency management information as necessary from all QICP sources to ensure appropriate route changes are completed to avoid new or developing hazardous weather conditions.
10. During conditions requiring emergency landing at a planned or unplanned divert location, the pilot shall access weather information required to make the appropriate landing preparations.
11. The UAS shall be able to avoid hazardous weather in the troposphere by maneuvering the UA in accordance with weather information provided by the HSI interface or ATC advisories. This requirement ensures the UAS is equipped with the capability for routine access to real time aviation weather information while airborne.

NOTE: Forecast information at altitudes FL450 and FL530 is available via special request (Reference: AT publication 7110.10R, paragraph 9-4-2).

- v. UAS aircraft pilots require the following radio communication and navigation flight weather briefing information for weather awareness, mission planning, safety of flight, contingency management and scheduled operations at or above FL430:
 1. Pilot weather briefing on flight communications and navigation impacts due to solar environmental events/activity recent, present and

- forecast including radio bursts, coronal mass ejections, solar flares, sudden ionospheric disturbances, or any other flight hazard affecting radio communications and navigation frequencies during flight.
2. Pilot considers all communication frequency and navigation information as appropriate to the mission, and proceeds per approval of the FAA during flight.
 3. Pilot has access to all QICP websites identifying communication and navigation data useful to flight.
 4. Prior to flight, pilot shall gather hazardous communication and navigation weather information and take the appropriate actions to complete UAS mission planning preparations.
 5. The UAS shall be able to mitigate communication and navigation impacts due to hazardous solar environmental and/or space weather conditions. This requirement ensures the UAS is able to communicate and navigate effectively while airborne.

NOTE: Forecast information at altitudes FL450 and FL530 is available via special request (Reference: AT publication 7110.10R, paragraph 9-4-2).

- b. *STEP 1 Procedures.* The process of developing weather support procedures for Access 5 HALE UAS flight operations will evolve over the life of the Access 5 program. This document provides an initial, set of support procedures for STEP 1 flight operations. These procedures are intended to provide a starting point for the STEP 1 scope of the Access 5 flight weather support process. As the initial and follow-on HALE UAS simulation and flight test events take place and weather impacts are better known, these procedures will evolve over time and will be expanded, refined, and updated accordingly. For the FY04 deliverable, an investigation was completed on key flight operations documents and resulted in outlining the Access 5 STEP 1 procedures listed below.
 - i. Access 5 (A5) UAS pilots access, monitor, and review AFSS/FSS flight weather briefing information and take the appropriate actions based on the following:
 1. Forecast and actual winds along the planned route and altitude.
 2. Forecast and actual air temperatures along the planned route and altitude.
 3. Forecast and observed areas of flight hazards along the planned route and altitude.
 4. Forecast and observed solar/space weather events and the affected communication and navigation of the flight.
 5. Updates to communication and navigation information affecting the planned route, altitude, and duration of the flight.

- ii. A5 UAS pilots review any applicable sections of Air Traffic order 7110.10R, Flight Services, with specific reference to Chapter 9, FAA Weather Services relating to the mission objectives for STEP 1 flight operations.

NOTE: FAA document, Advisory Circular (AC) 00-45E, December 1999 (revised), Aviation Weather Services, is the Air Traffic publication weather services reference in publication 7110.10R for detailed information on weather services provided to FAA certified aircraft.

- iii. A5 UAS pilots make any necessary arrangements for compliance regarding weather knowledge requirements relating to Air Traffic order 7210.3T, Facility Operation and Administration, with specific reference to Part 4, Chapter 14, Aviation Meteorological Services and Equipment.
- iv. A5 UAS pilots make the necessary arrangements to have the highest speed access to ATC Service A circuits to receive updated weather information.
- v. While operating aircraft at STEP 1 altitudes, A5 UAS pilots have access to and monitor AIRMETs/SIGMETs and other available hazard information such as HIWAS or on-board visual monitoring devices.
- vi. A5 UAS pilots monitor weather sources for updates and take the appropriate routine and contingency actions regarding route adjustments based on the following weather criteria for STEP 1 flight information at or above FL430:
 - 1. Forecast winds at the expected operating altitude at or above FL430
 - 2. Forecast temperatures at the expected operating altitude
 - 3. Forecast areas of flight hazards (turbulence or icing) of any intensity at the expected operating altitude at or above FL430
 - 4. Forecast areas of thunderstorms along or near the route of flight.
 - 5. Recent, current and forecast solar environmental events/activity that could affect radio communications and navigation of flight at or above FL430.
 - 6. Updated weather information affecting contingency management and emergency divert weather for flight missions at or above FL430.
- vii. A5 UAS pilots conduct the necessary contingency management planning for contingencies affecting flight at FL430 or above.

NOTE: Forecast information at altitudes FL450 and FL530 is available via special request (Reference: AT publication 7110.10R, paragraph 9-4-2).

- 7. *Step 1 Flight Scenario.* To test the validity of gathering and employing weather information for a Step 1 mission profile, a flight scenario was created for a two-day mission. This scenario is presented as a separate Microsoft PowerPoint attachment (WX_001 Appendix A). The information included in the PowerPoint presentation includes sample data and products

related to the each mission segment. In addition, this scenario was used as an initial verification and validation of the Step 1 Weather Functional Requirements.

8. References. The references used to develop the requirements are listed below. Where possible the most current web-available references were used to discern the specific weather support requirements for Access 5 HALE UAS STEP 1 operations.
 - a. Air Traffic publication 7110.10R, Flight Services, August 5, 2004
 - b. Air Traffic Order 7210.3T, Facility Operation and Administration, August 5, 2004
 - c. Air Traffic Aeronautical Information Manual, August 5, 2004
 - d. FAA Advisory Circular, AC 00-45E, Aviation Weather Services, Revised December 1999
 - e. FAA Advisory Circular, AC 90-99, High Altitude Airspace Redesign Phase 1, September 22, 2003
 - f. FAA Advisory Circular, AC 00-62, Internet Communications of Aviation Weather and NOTAMs
 - g. National Airspace System Weather Functional Analysis, FAA Workgroup Report, February 12, 2004
 - h. FAA Guide, FAA-G-8082-13A, Instrument Rating Knowledge Test Guide, October 15, 2003
 - i. National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) Space Environment Center, <http://www.sec.noaa.gov/index.html>
 - j. National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS), Aviation Weather Center (AWC), Aviation Digital Data Service (ADDS), <http://adds.aviationweather.noaa.gov/>
 - k. Functional Requirements Document for HALE UAS Operations in the NAS, Step 1, Version 2, September 2005

Verification Matrix

| FRD #/ Description | Verification Method | Additional Verification Required |
|--|--|--|
| 5.4.3 Avoid Hazardous Weather | Flight scenario created to determine open internet access to weather data | Flight Simulation and Flight Demonstration |
| 5.4.3.1 Maintain Weather Awareness | Flight scenario weather awareness data and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |
| 5.4.3.1.1 Gather Weather Information | Flight scenario weather awareness data and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |
| 5.4.3.1.1.1 Request Weather Information (HSI F8b) | Flight scenario weather awareness data and information accessed via open internet at ADDS | HSI, Flight Simulation, and Flight Demonstration |
| 5.4.3.1.1.2 Convey Weather Information to the UAS Pilot (HSI F8a) | NA, need HSI verification | HSI, Flight Simulation and Flight Demonstration |
| 5.4.3.1.2 Evaluate Potential for Weather Conflicts | Flight scenario weather awareness data and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |
| 5.4.3.2 Coordinate Weather Avoidance Maneuver | Flight scenario weather awareness data and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |
| 5.4.3.3 Command Weather Avoidance Maneuver | Flight scenario weather awareness data and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |
| 5.4.3.3.1 Control the Weather Awareness System (HSI F8c) | NA, need HSI verification | HSI, Flight Simulation and Flight Demonstration |
| 5.4.3.4 Execute the Weather Avoidance Maneuver | Flight scenario weather awareness data for contingency scenario and information accessed via open internet at ADDS | Flight Simulation and Flight Demonstration |



WWX_001 Appendix A



*The following document was prepared by a collaborative team through the noted work package.
This was a funded effort under the Access 5 Project*

Flight Scenario

A High Altitude Long Endurance (HALE) Unmanned Air System (UAS) flight was conducted between 8 September 2005 and 10 September 2005 to collect chemical data from upper air (FL480) systems i.e. ozone concentration, NOx levels, etc.

This flight began on 8 September 2005 from Edwards Air Force Base in southern California and ended on 10 September 2005 at Andrews Air Force Base in the Washington D.C. area.

During the mission there were two orbiting/data collection sessions which took place enroute to Andrews from Edwards. Each orbiting/data collection session lasted approximately 12 hours. The orbiting sessions were conducted between Denver, CO and Kansas City, MO and between Indianapolis, IN and Detroit, MI.

This presentation is designed to show that sources of flight weather information are readily available to UAS pilots to conduct successful UAS missions in the NAS. All weather information for this presentation was obtained from the public internet. Weather information closest to the mission times is presented.

Assumptions:

UAS cruises at 200 kts

Climb to and descent from altitude FL480 takes 1.5 hours

Our Mission Objectives

The objectives of this mission are as follows:

- To depict the necessary weather data that must be accessible via a QICP weather provider to UAV pilots in order to conduct safe and successful missions
- To explain the knowledge that must be extrapolated from the weather data sources
- To show the complexity of forecasting weather for HALLE missions
- To show potential contingency scenarios that may result from emergency situations
- To show the importance of weather to the overall success of the mission.

Schedule of Flight

- Begin:** Edwards AFB 1700 UTC (10:00 am PDT) 8 September 2005
Collected the following weather information:
Turbulence data, Convective Wx Sigmet/Airmet, Winds/Temps, Icing,
METAR, Satellite
- *Arrive Denver, CO 2330 UTC 8 September 2005
Initiate data collection mission
- *Arrive Kansas City, MO 0230 UTC 9 September 2005
Enter orbit area for data collection mission
- *Orbit between Kansas City and Denver for approximately 12 hours from
0230 UTC to 1430 UTC on 9 September 2005.

Schedule of Flight (cont.)

* Arrive Indianapolis, IN 1900 UTC 9 September 2005.

Initiate data collection mission

* Arrive Detroit, MI 2230 UTC 9 September 2005

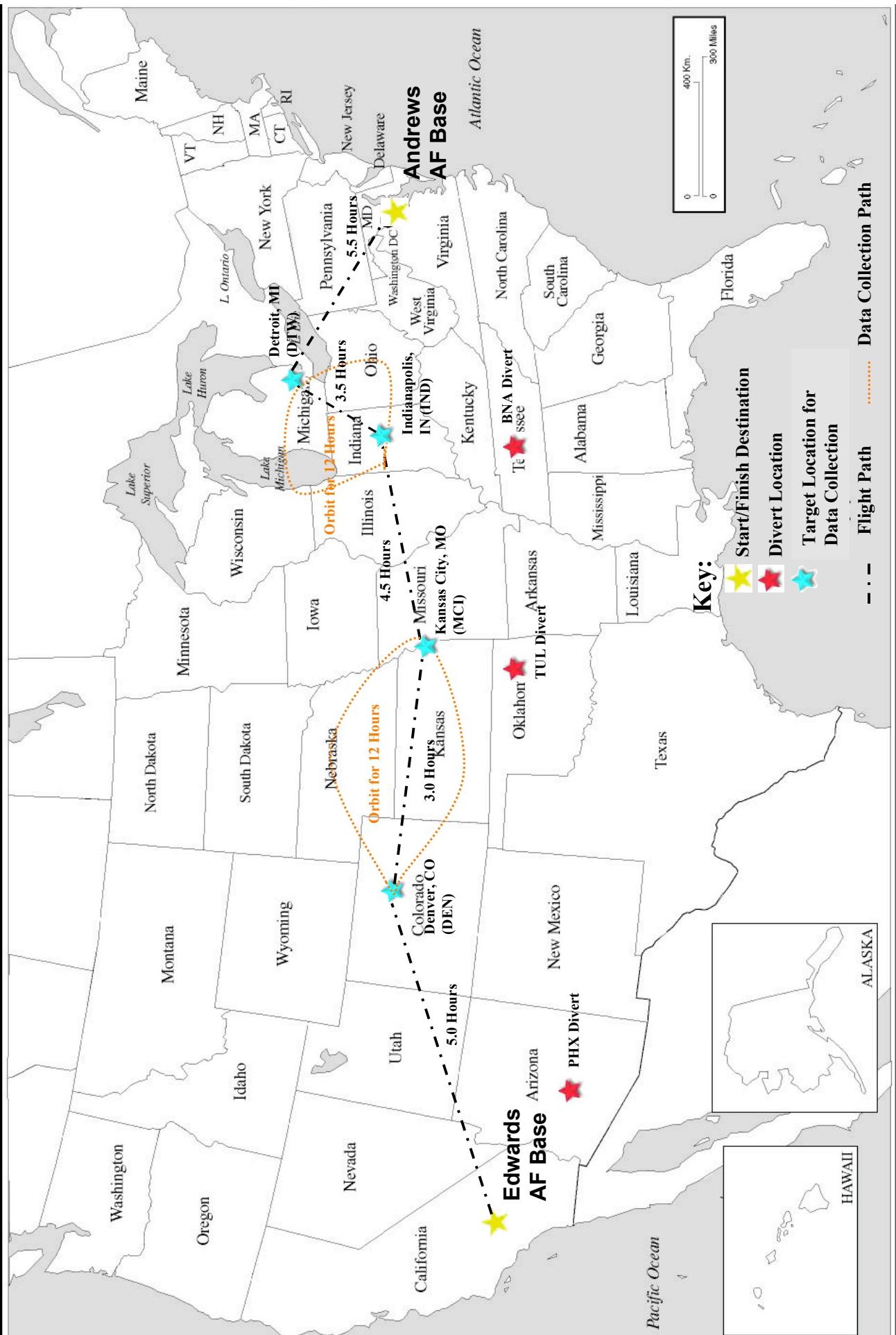
Enter orbit area for data collection mission

* Orbit between Indianapolis and Detroit for approximately 12 hours from 2230 UTC 9 September 2005 to 1030 UTC 10 September 2005.

Proceed to Andrews AFB to complete flight

Finish: Arrive and descend at Andrews AFB at approximately 1600 UTC on 10 September 2005.

Access 5 Step One Flight Scenario Route



Weather Data Gathered for Takeoff from Edwards Air Force Base

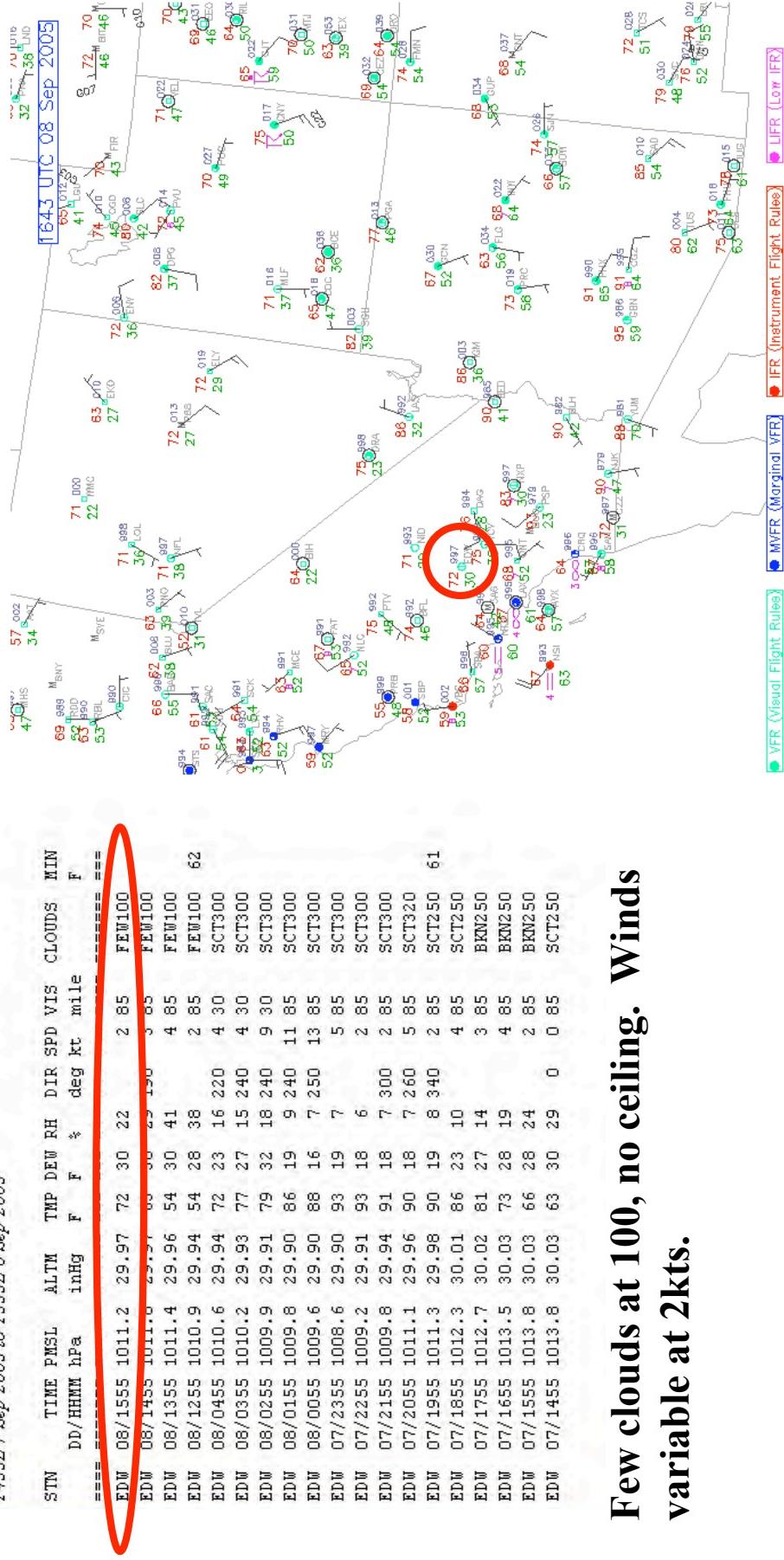
116Z Takeoff weather for Edwards:

Observations for EDWARDS, CA (EDW)

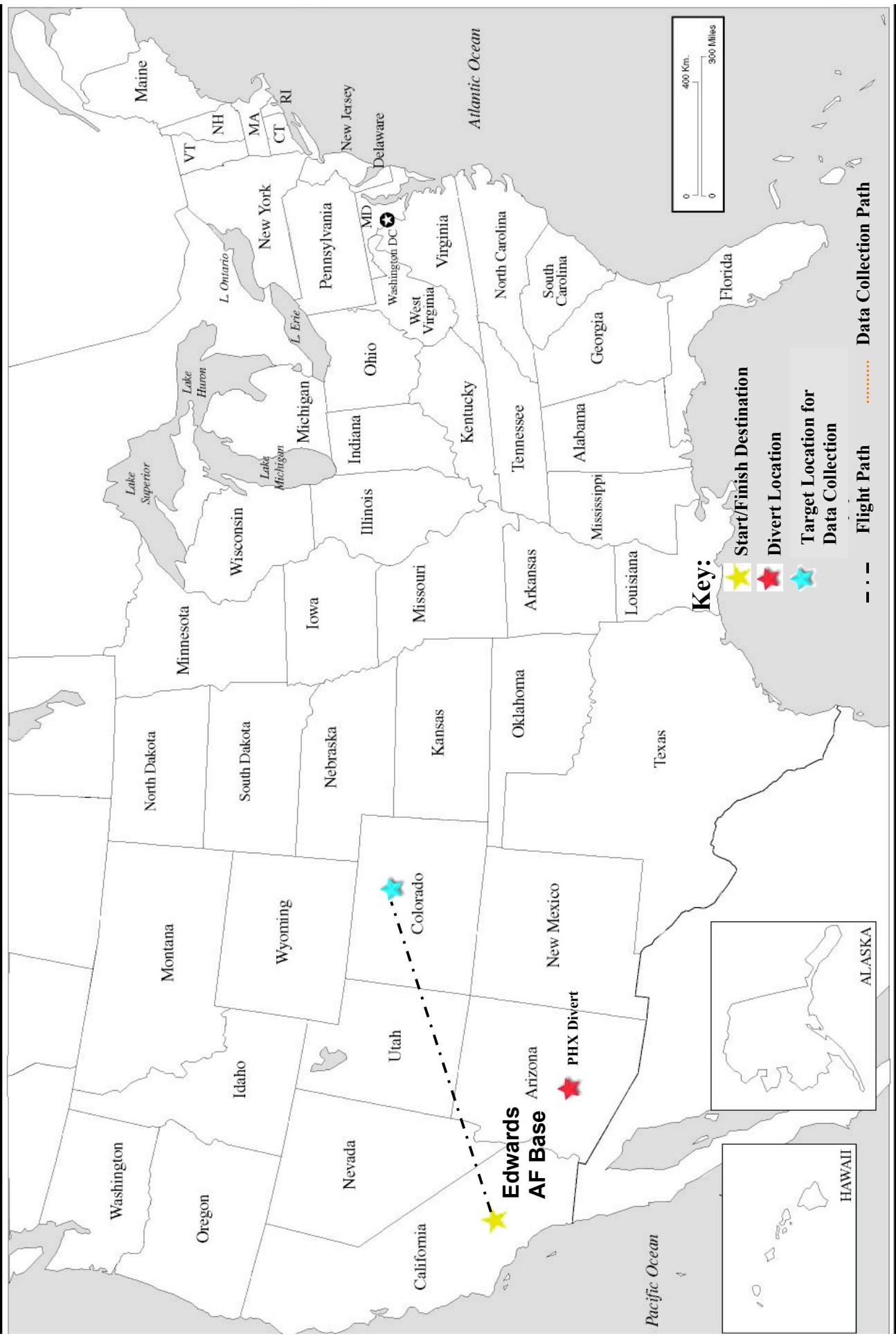
145527 Sep 2005 to 155528 Sep 2005

| STN | TIME | PMSL | ALTM | TMP | DEW | RH | DIR | SPD | VIS | CLOUDS | MIN |
|-----|---------|--------|-------|-----|-----|----|-----|-----|-------|--------|-----|
| | DD/HMM | hPa | inHg | F | F | % | deg | kt | mile | | F |
| EDW | 08/1555 | 1011.2 | 29.97 | 72 | 30 | 22 | 285 | | FEW00 | | |
| EDW | 08/1455 | 1011.0 | 29.2 | 93 | 90 | 22 | 120 | 3 | 85 | FEW00 | |
| EDW | 08/1355 | 1011.4 | 29.96 | 54 | 30 | 41 | | 4 | 85 | FEW00 | |
| EDW | 08/1255 | 1010.9 | 29.94 | 54 | 28 | 38 | | 2 | 85 | FEW00 | 62 |
| EDW | 08/0455 | 1010.6 | 29.94 | 72 | 23 | 16 | 220 | 4 | 30 | SCT00 | |
| EDW | 08/0355 | 1010.2 | 29.93 | 77 | 27 | 15 | 240 | 4 | 30 | SCT00 | |
| EDW | 08/0255 | 1009.9 | 29.91 | 79 | 32 | 18 | 240 | 9 | 30 | SCT00 | |
| EDW | 08/0155 | 1009.8 | 29.90 | 86 | 19 | 9 | 240 | 11 | 85 | SCT00 | |
| EDW | 08/0055 | 1009.6 | 29.90 | 88 | 16 | 7 | 250 | 13 | 85 | SCT00 | |
| EDW | 07/2355 | 1008.6 | 29.90 | 93 | 19 | 7 | | 5 | 85 | SCT00 | |
| EDW | 07/2255 | 1009.2 | 29.91 | 93 | 18 | 6 | | 2 | 85 | SCT00 | |
| EDW | 07/2155 | 1009.8 | 29.94 | 91 | 18 | 7 | 300 | 2 | 85 | SCT00 | |
| EDW | 07/2055 | 1011.1 | 29.96 | 90 | 18 | 7 | 260 | 5 | 85 | SCT020 | |
| EDW | 07/1955 | 1011.3 | 29.98 | 90 | 19 | 8 | 340 | 2 | 85 | SCT250 | 61 |
| EDW | 07/1855 | 1012.3 | 30.01 | 86 | 23 | 10 | | 4 | 85 | SCT250 | |
| EDW | 07/1755 | 1012.7 | 30.02 | 81 | 27 | 14 | | 3 | 85 | BKN250 | |
| EDW | 07/1655 | 1013.5 | 30.03 | 73 | 28 | 19 | | 4 | 85 | BKN250 | |
| EDW | 07/1555 | 1013.8 | 30.03 | 66 | 28 | 24 | | 2 | 85 | BKN250 | |
| EDW | 07/1455 | 1013.8 | 30.03 | 63 | 30 | 29 | | 0 | 85 | SCT250 | |

Local area weather chart at takeoff time



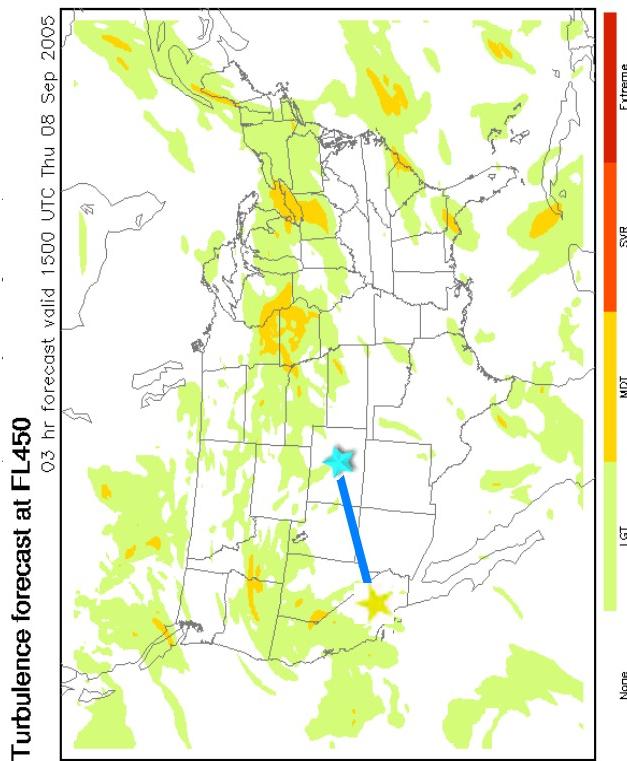
Flight Scenario First Leg



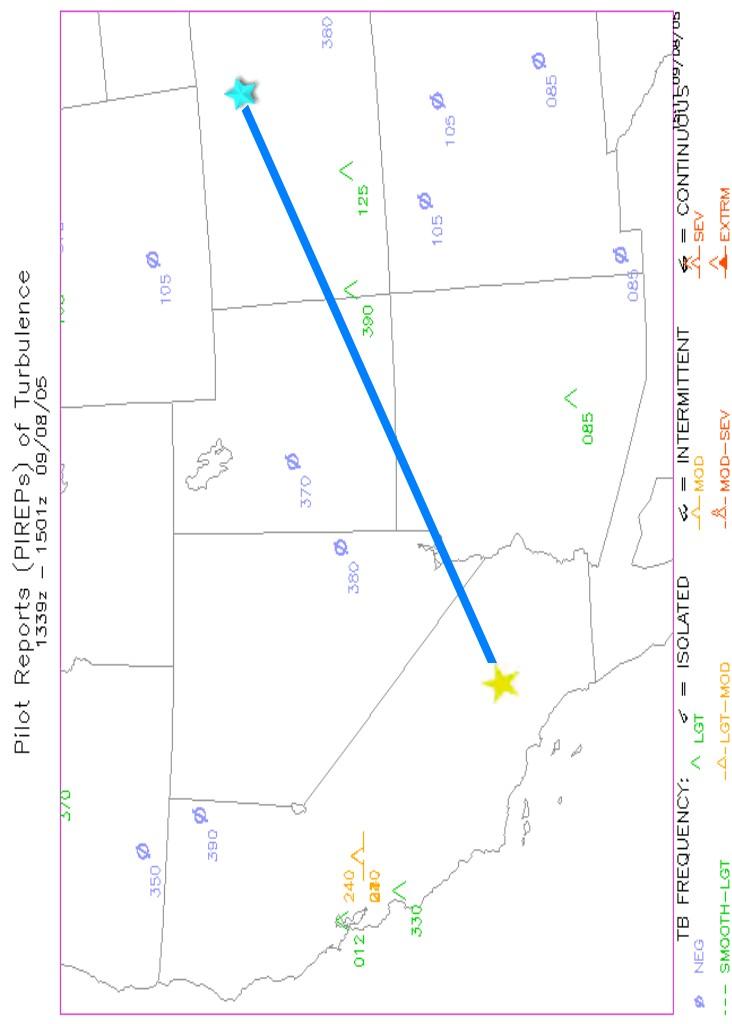
Weather Data Gathered for Takeoff from Edwards AFB and Climb to FL480

Turbulence:

Pilot Reports (PIREPs) valid
1500 UTC indicate favorable
weather for takeoff and
during climb to altitude of
FL480:



No turbulence forecast is
expected to affect takeoff and
climb to FL480.



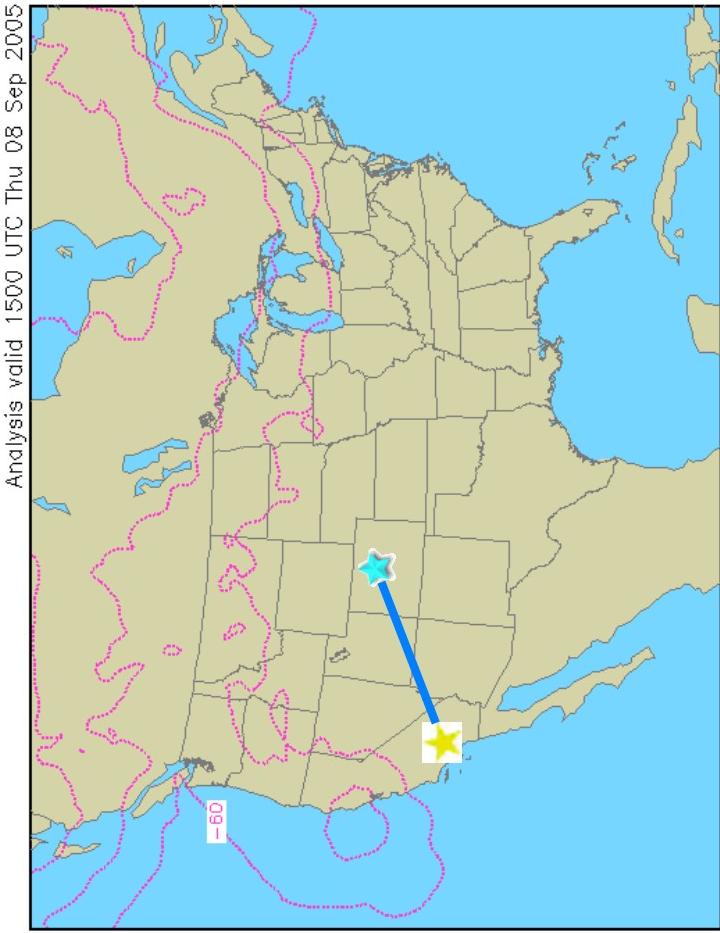
Wind Speed:

Wind Speed Analysis for
FL480 over the Contiguous
United States at 1500 UTC:

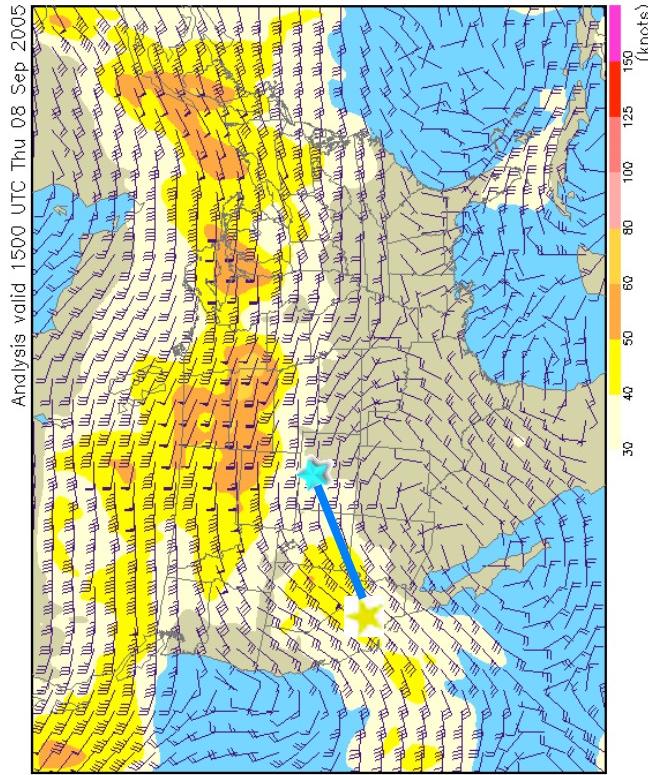
Temperature:

Temperature Forecast for
FL480 over the Contiguous
United States at 1500 UTC:

Temperature ($^{\circ}\text{C}$) at 48,000 ft MSL (125 mb)



Wind speed (kts) at 48,000 ft MSL (125 mb)



Analysis valid 1500 UTC Thu 08 Sep 2005

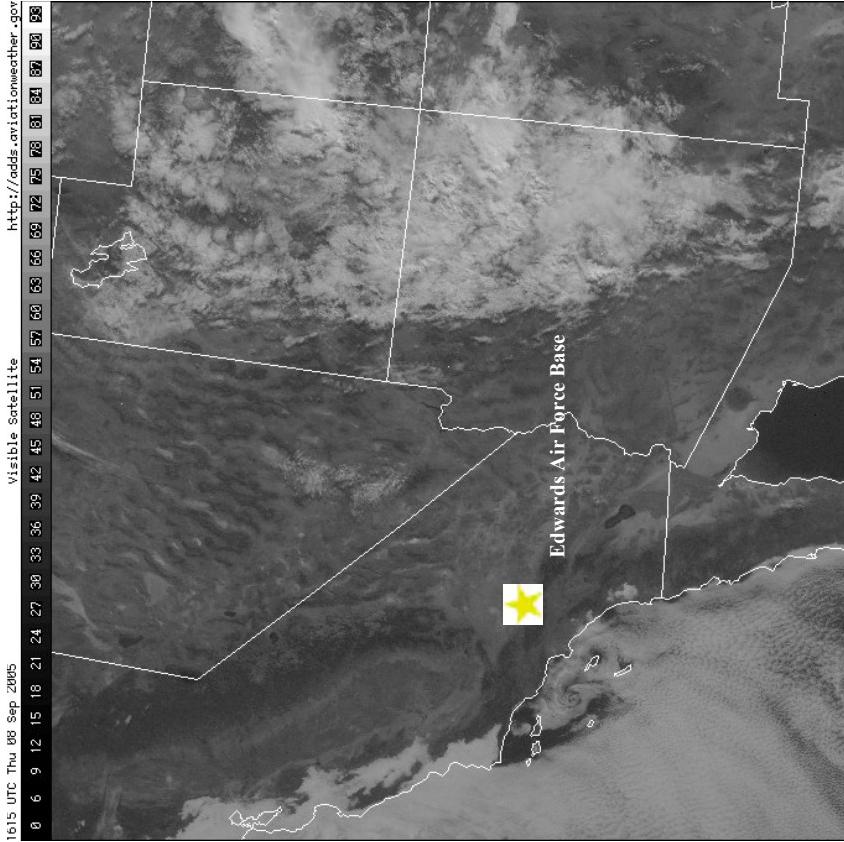
FL480 enroute winds
from Edwards AFB to
Denver orbit area
average 40 knots from
the southwest

The temperature is
approximately -60 degrees
Celsius at FL480.

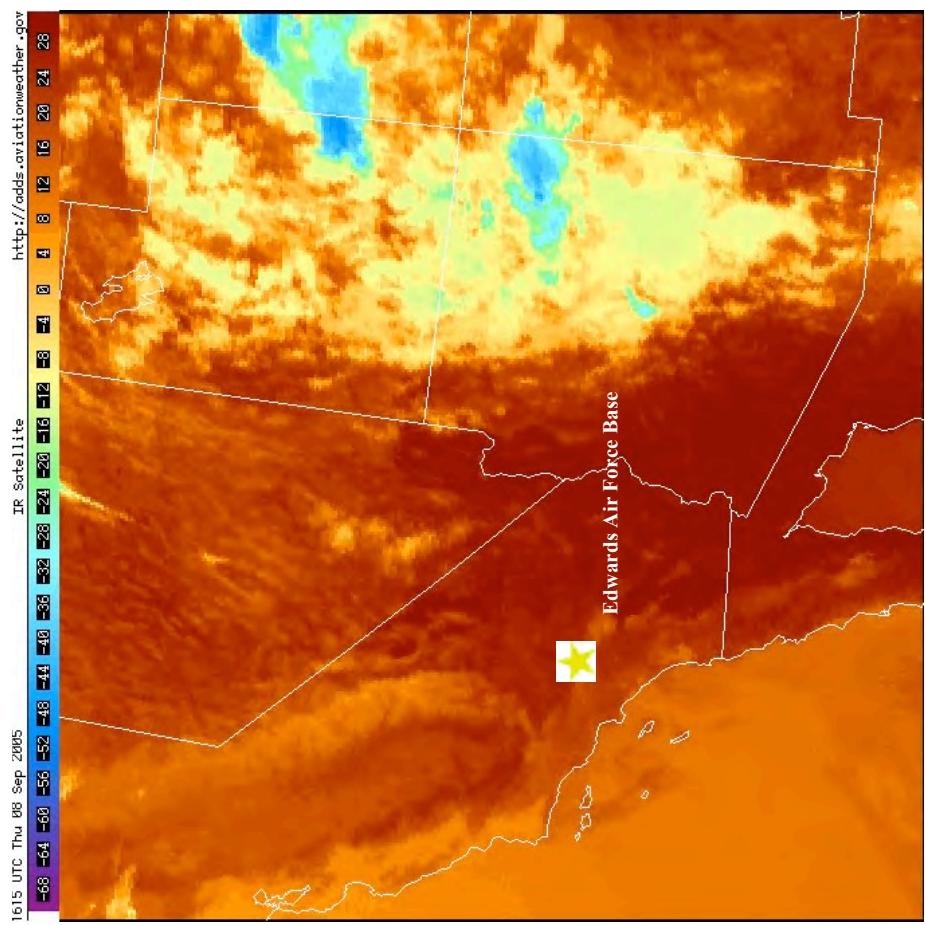
Satellite Imagery:

Visible Satellite Imagery
for Edwards AFB and
surrounding Area: →

Infrared satellite imagery at 1615Z indicates
showers and possible isolated thunderstorms
later in the day over N Arizona and E
Utah/central Colorado. These could affect
the entry into the Denver orbit area.



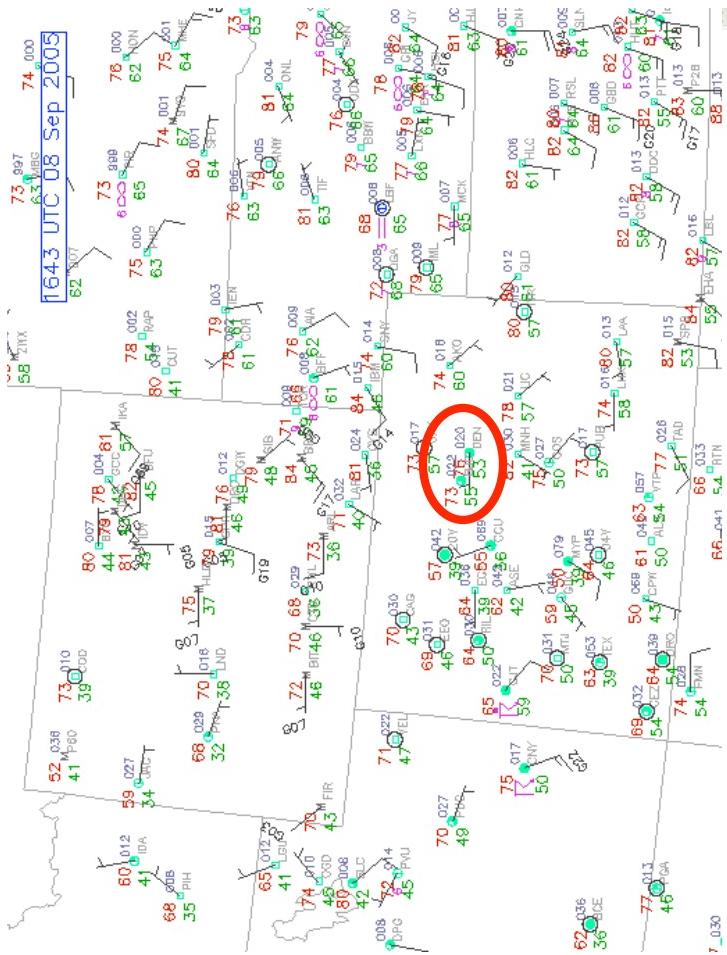
Visible satellite imagery at 1615Z
indicates some clouds located over the N
Arizona and E Utah/central Colorado
area.



Infrared Radar Imagery from Edwards
AFB and surrounding Area: ↓

METAR Outlook for the Denver Area:

Broken clouds with ceiling at 200. Winds from the west at 10 knots. Thunderstorms beginning at 2224 UTC were present with occasional cloud to ground lightning to the northeast with additional distant thunderstorms to the northeast-east moving toward the northeast.



Observations for DENVER, CO (DEN)

KDEN 082253Z 23010KT 10SM TS FEW080CB SCT095 32/06 A3006 RMK A02 TSB24 SLP095 OCNL LTGCG VC NE AND DSNT NE-E TS VC ME MOV SLO NE VIRGA DSNT A
KDEN 082230Z 190114G23KT 10SM TS FEW080CB SCT095 32/06 A3006 RMK A02 TSB24 OCNL LTGCG VC NE AND DSNT NE-E TS VC ME MOV SLO NE VIRGA DSNT NO
KDEN 082153Z 33006KT 10SM TS SCT095 32/06 A3006 RMK A02 TSB24 OCNL LTGCG DSNT NE-E TS VC ME MOV SLO NE SHRA
KDEN 082053Z 32009G15KT 10SM SCT080 BKN130 BKN220 32/08 A3010 RMK A02 SLP107 OCNL LTGCG DSNT SE-S AND W CB DSNT SE-S MOV E TCU VC ME TO3170078
KDEN 081953Z 32007KT 300V360 10SM FEW090 SCT130 BKN220 32/06 A3012 RMK A02 SLP112 VIRGA DSNT SE-S AND W TCU DSNT SE-S TO3170061
KDEN 081853Z 31008KT 10SM FEW080 SCT110 SCT150 BKN220 31/08 A3015 RMK A02 SLP120 VIRGA DSNT S-W ACSL DSNT E TO3110083
KDEN 081753Z VRB03KT 10SM FEW080 SCT110 BKN220 28/08 A3018 RMK A02 SLP132 TCU DSNT S ACSL DSNT E AND W TO2830083 10300 20139 58007
KDEN 081653Z 00000KT 10SM FEW090 BRN130 BKN220 27/10 A3019 RMK A02 SLP141 TO2670100
KDEN 081553Z 27005KT 10SM FEW090 SCT130 BKN220 24/12 A3020 RMK A02 SLP144 ACSL DSNT SW-W TO2330100 51002
KDEN 081453Z 29004KT 10SM FEW100 BKN120 BKN220 23/10 A3020 RMK A02 SLP145 TO2440117
KDEN 081353Z 24007KT 10SM FEW100 BKN120 BKN220 19/11 A3020 RMK A02 SLP149 TO1940111
KDEN 081253Z 25006KT 10SM BKN120 BKN220 15/11 A3019 RMK A02 SLP148 TO1500111
KDEN 081153Z VRB05KT 10SM SCT120 BKN220 17/11 A3019 RMK A02 SLP139 TO1670111 10200 20139 58002
KDEN 081053Z VRB05KT 10SM FEW090 SCT110 BKN220 14/11 A3020 RMK A02 SLP145 TO1390106
KDEN 080953Z COR 31005KT 10SM FEW110 SCT200 17/12 A3020 RMK A02 SLP139 TO1720117
KDEN 080853Z 26006KT 10SM SCT110 BKN220 17/11 A3020 RMK A02 SLP139 TO1720111 58005
KDEN 080753Z 26008KT 10SM FEW110 SCT200 18/12 A3021 RMK A02 SLP144 TO1830117
KDEN 080653Z 19014KT 10SM SCT110 SCT200 19/12 A3021 RMK A02 SLP144 TO1940117 403220122
KDEN 080553Z 16012KT 10SM SCT110 SCT200 20/11 A3022 RMK A02 SLP149 TO2000011 10306 20200 50005
KDEN 080453Z 13013KT 10SM SCT110 BKN220 20/12 A3022 RMK A02 SLP154 TO2000017
KDEN 080353Z 13012KT 10SM FEW080 BKN110 BKN220 23/11 A3021 RMK A02 SLP151 CB MOV E TO2280111
KDEN 080253Z 12006KT 10SM FEW080 SCT120 BKN220 23/09 A3020 RMK A02 SLP149 OCNL LTGCG DSNT E CB DSNT E MOV E TO2330089 53008
KDEN 080153Z 15008KT 10SM FEW080 SCT130 SCT200 23/06 A3018 RMK A02 SLP149 OCNL LTGCG DSNT E AND SE CB DSNT E AND SE MOV E TO2330056
KDEN 080053Z 05007KT 10SM FEW080 SCT130 SCT200 28/02 A3017 RMK A02 SLP140 VIRGA DSNT W CB DSNT E AND SE AND SW MOV E TCU DSNT S TO2780017
KDEN 072353Z VRB04KT 10SM FEW080 SCT130 SCT200 31/01 A3017 RMK A02 SLP135 VIRGA DSNT W CB DSNT NE AND SE MOV E TCU DSNT S TO3060006 10322 20261 56010
KDEN 072253Z VRB06KT 10SM FEW085 SCT120 SCT200 32/01 A3018 RMK A02 SLP140 VIRGA DSNT W CB DSNT NE AND SE MOV E TCU DSNT S TO3170011
KDEN 072153Z VRB05KT 10SM FEW080 SCT120 SCT200 32/02 A3019 RMK A02 SLP142 CB DSNT N MOV E TCU DSNT E-S TO3170022

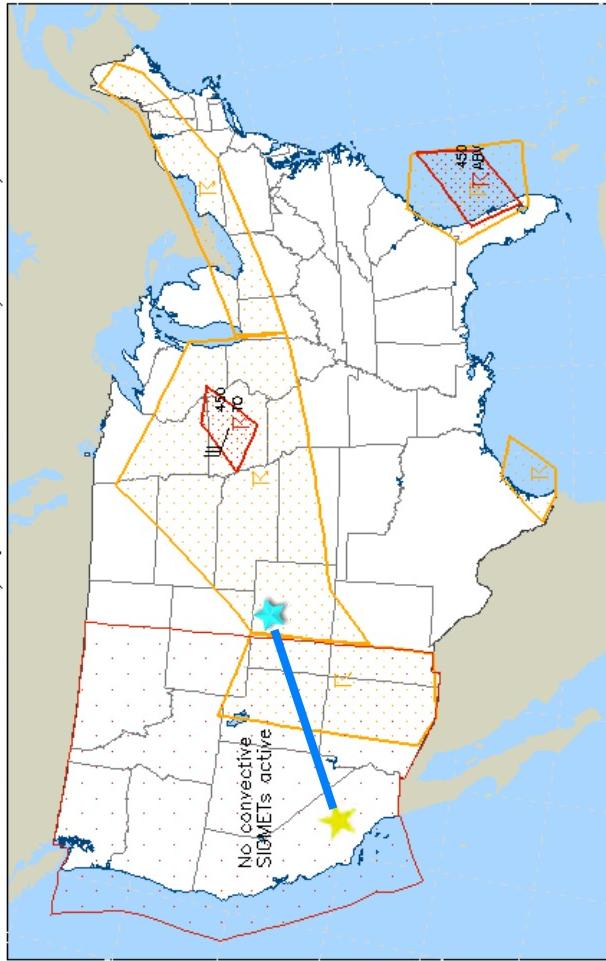
Significant Weather Advisories:

Convective SIGMET for the Contiguous U.S.:

There is the potential for isolated convective weather for this portion of flight.

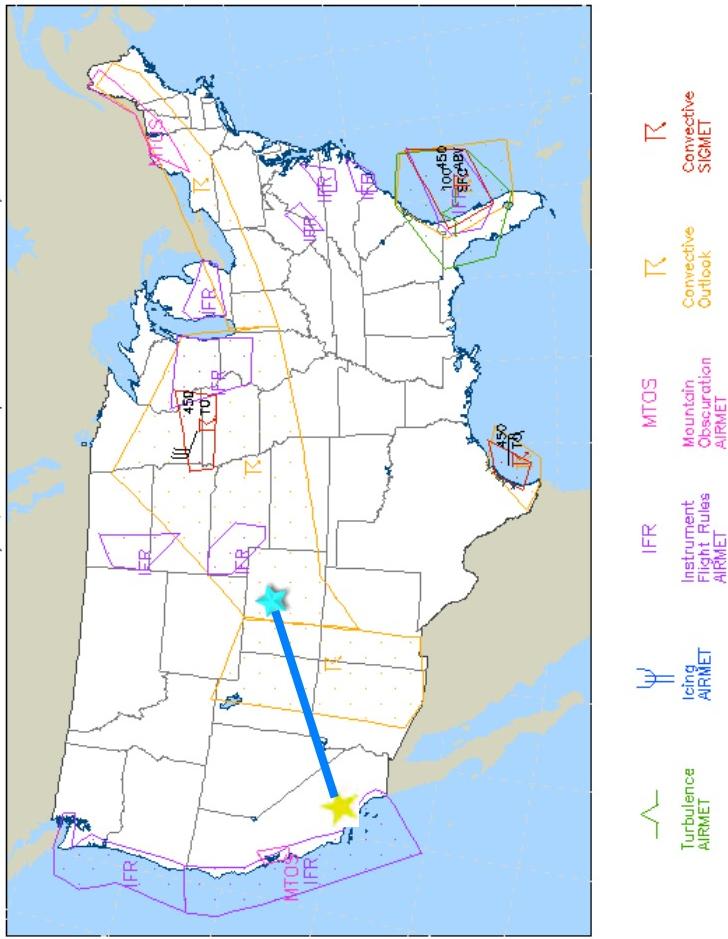
Convective SIGMETs (red) and outlooks (orange)

chart created at 1655 UTC Thu 08 Sep 2005
SIGMETs valid until 1855z/8th, Outlooks valid from 1855z/8th to 2255z/8th



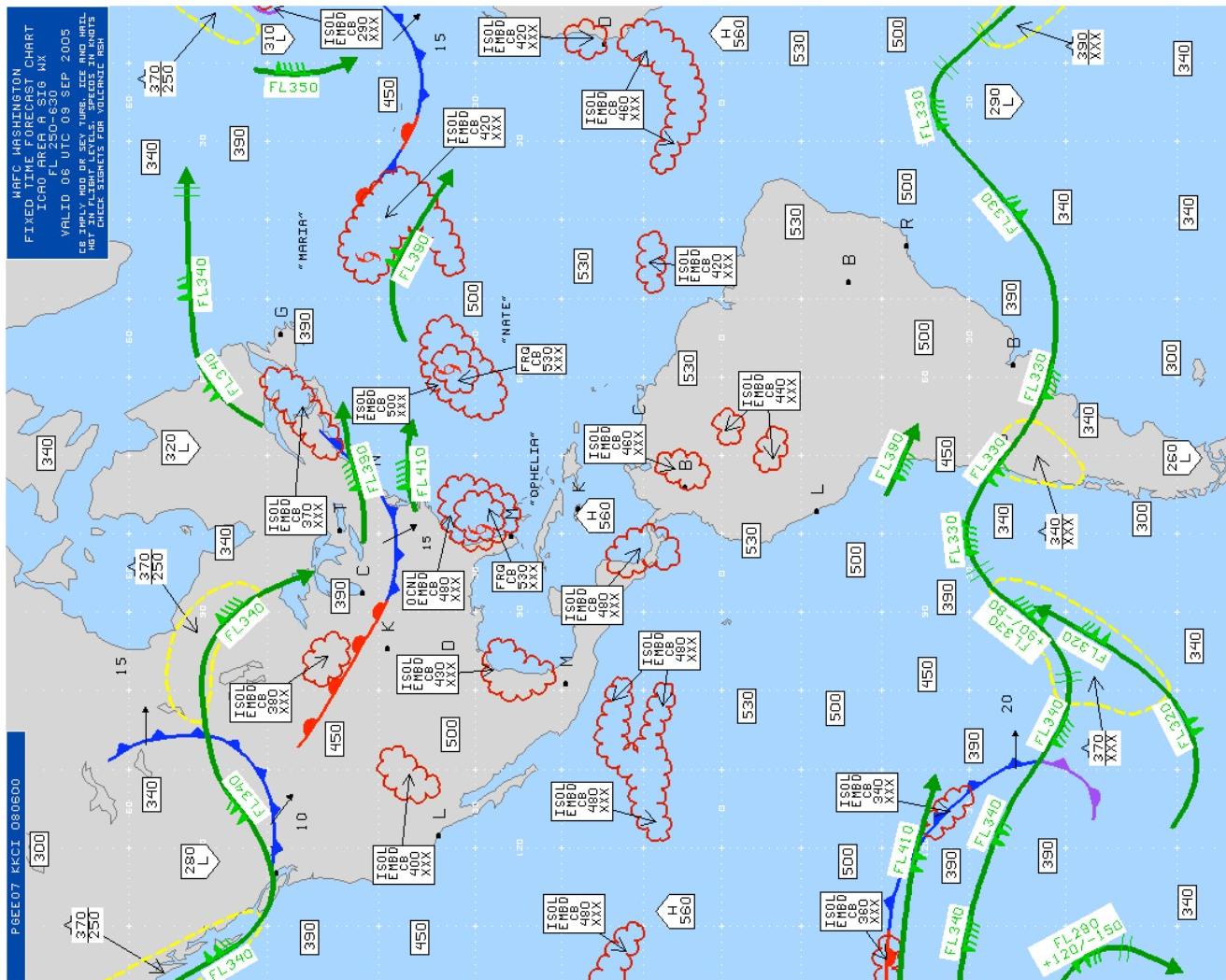
All active AIRMETs and SIGMETs for the continental U.S.:

All active AIRMETs and SIGMETs
chart created at 1455 UTC Thu 08 Sep 2005
AIRMETs valid until 2000z/8th, SIGMETs expire at or before 1655z/8th



High-Level Weather Fixed Time Forecast Chart for FL250-FL630:

No significant weather for our mission profile.

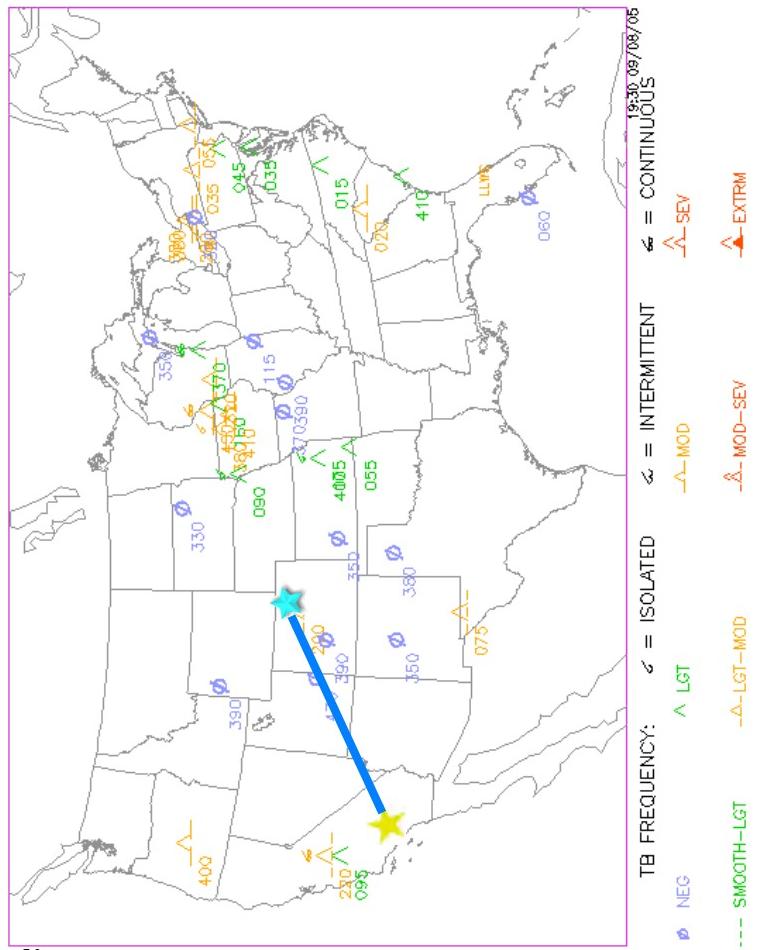


Divert Weather:

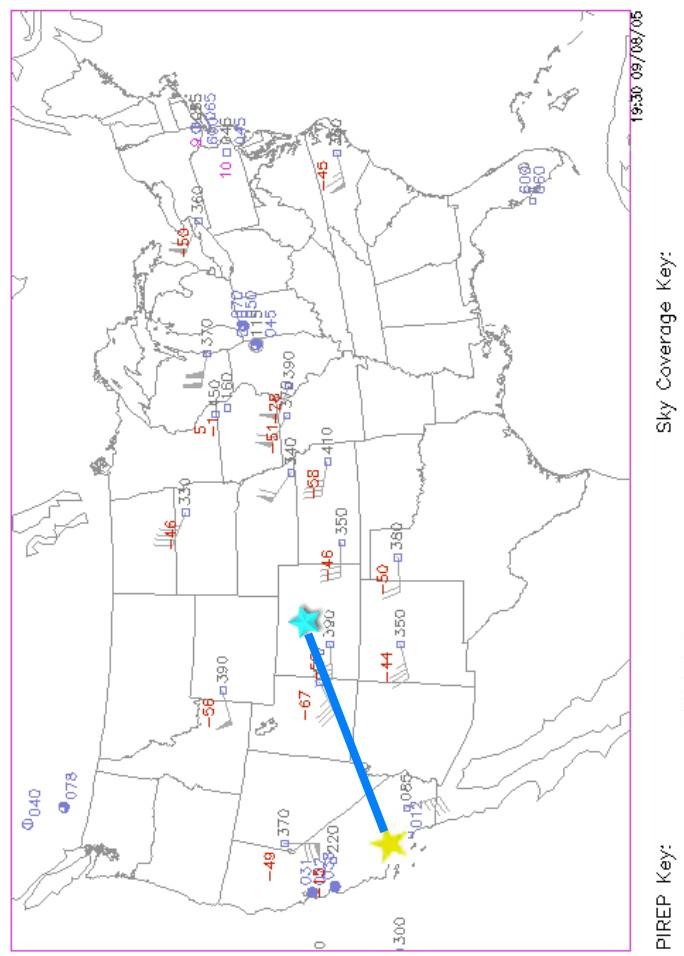
PIREPs Turbulence for the
Continental U.S. on 8
September 2005:

**There is light to moderate
turbulence in the Denver
area at this time.**

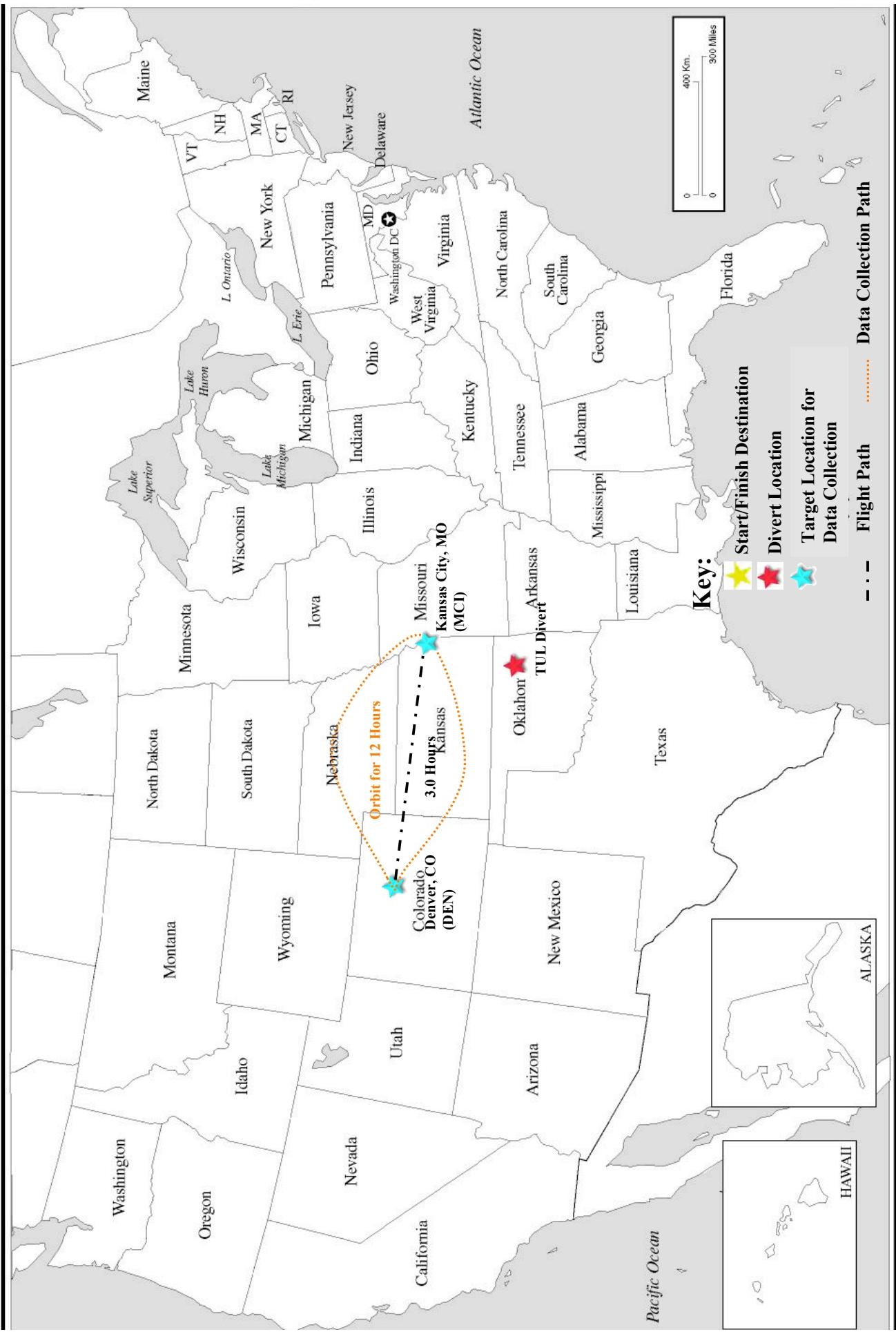
Pilot Reports (PIREPs) of Turbulence
1800z – 1919z 09/08/05



Pilot Reports (PIREPs) of Weather and Sky Conditions
1759z – 1925z 09/08/05



Flight Scenario First Orbit Area



**Current mission time: approximately 2330
UTC on 8 September 2005**

**Flight status: entering mission orbit
area 1, and heading to Kansas City,
MO for 0230 UTC on 9 September
2005.**

Turbulence AIRMETs (green) and SIGMETs (red)
chart created at 1956 UTC Thu 08 Sep 2005
AIRMETs valid until 0200z/9th, SIGMETs expire at or before 2155z/8th

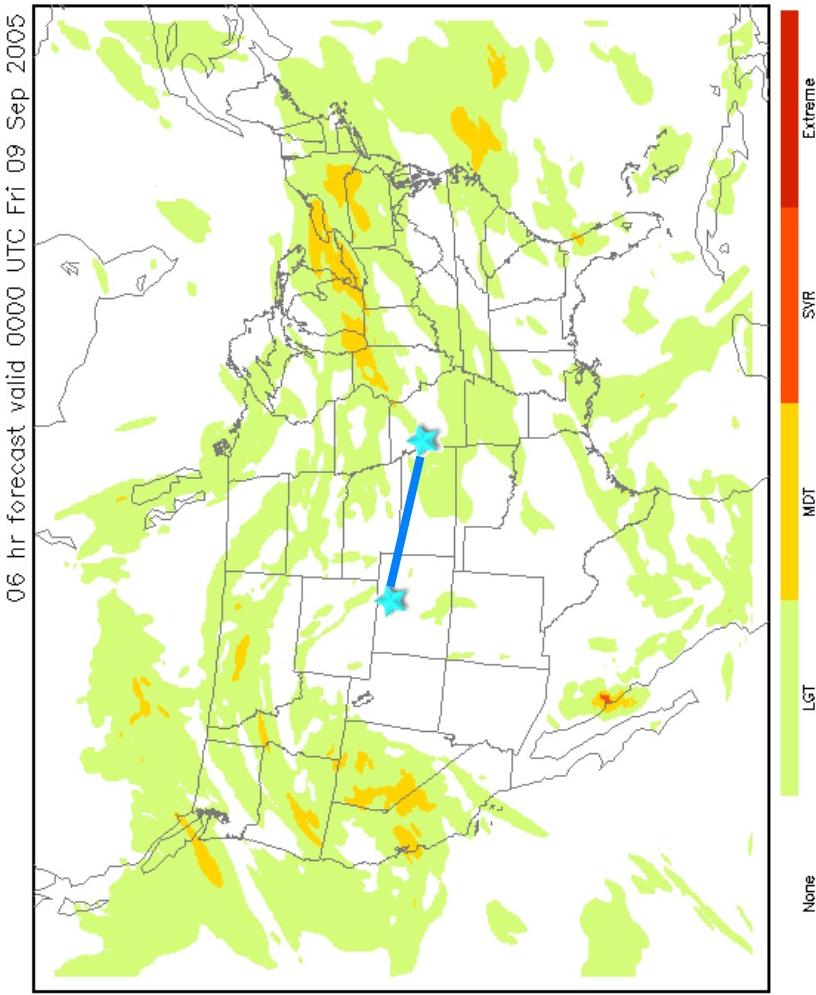


Turbulence Forecast at
FL450 for 0000 UTC on
9 September 2005:



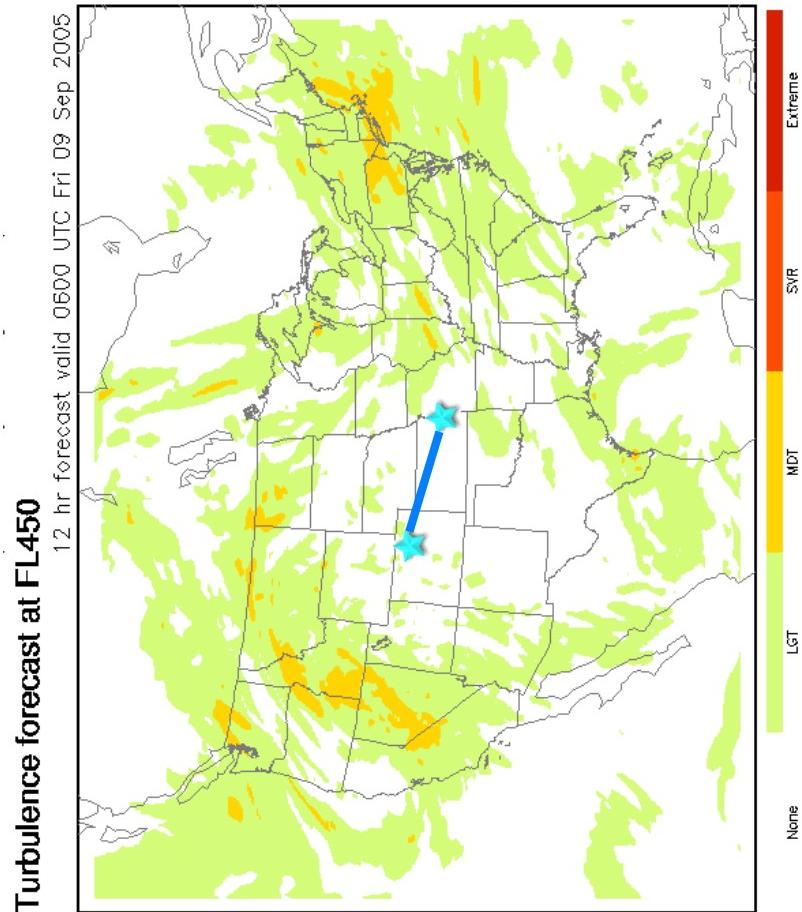
**Heading from Denver, CO to Kansas
City, MO and orbiting for 12 hours
in between the two locations
beginning data collection.**

Turbulence forecast at FL450



Turbulence of light intensity or less is
expected along the flight path.

Turbulence Forecast at FL450 for
0600 UTC on 9 September 2005:

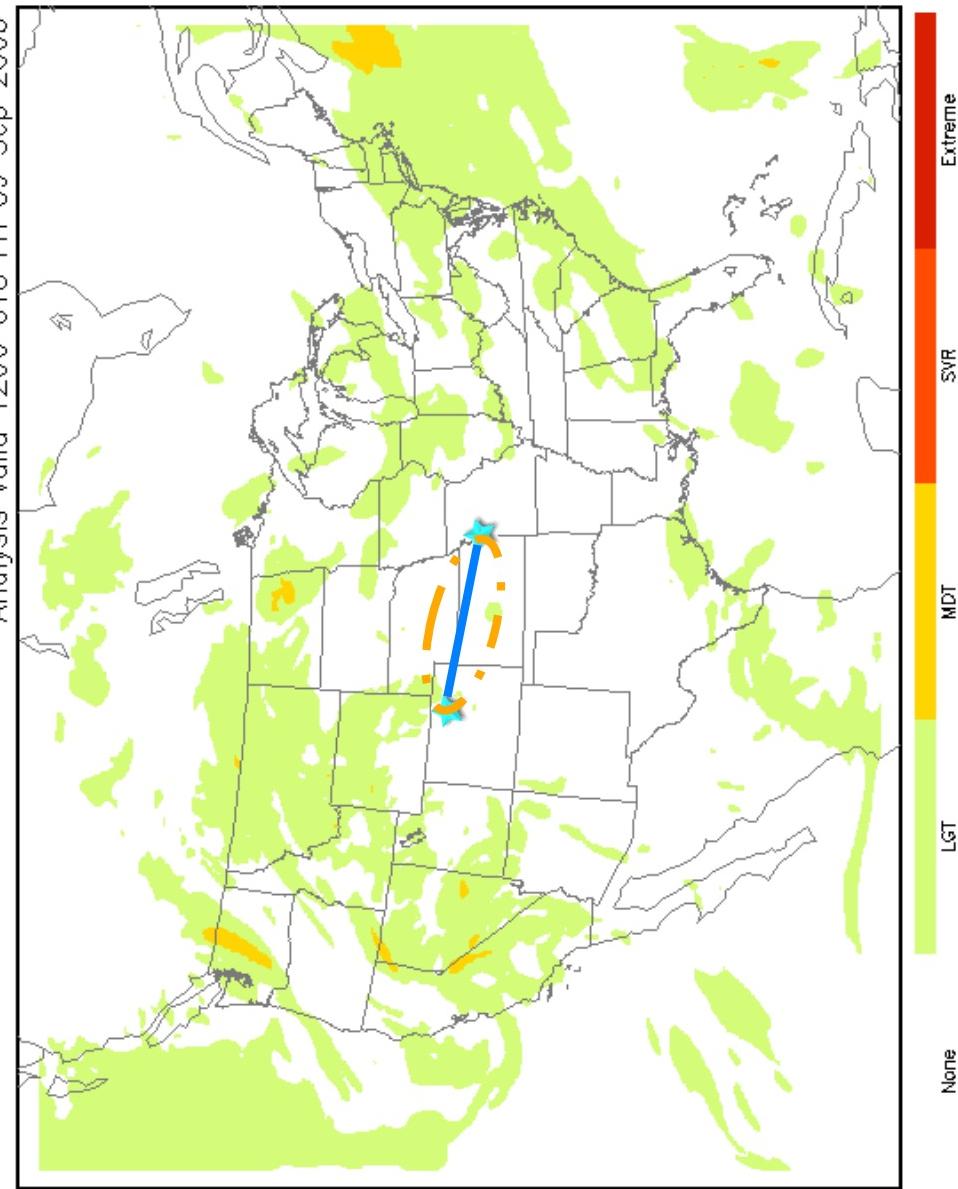


Turbulence forecast at FL450
valid 1200 UTC on 9
September 2005.

Turbulence forecast at FL450

Currently orbiting and
collecting data between
Denver, CO and Kansas
City, MO.

There is light to moderate
turbulence for FL450 in
the western orbit area
during this portion of
flight.



Turbulence AIRMETs and SIGMETs as of
1355 UTC on 9 September 2005:

**Turbulence is
expected from
surface to FL080
between Denver and
Kansas City.**

**This would affect any
divert to Kansas
City.**

Turbulence AIRMETs (green) and SIGMETs (red)

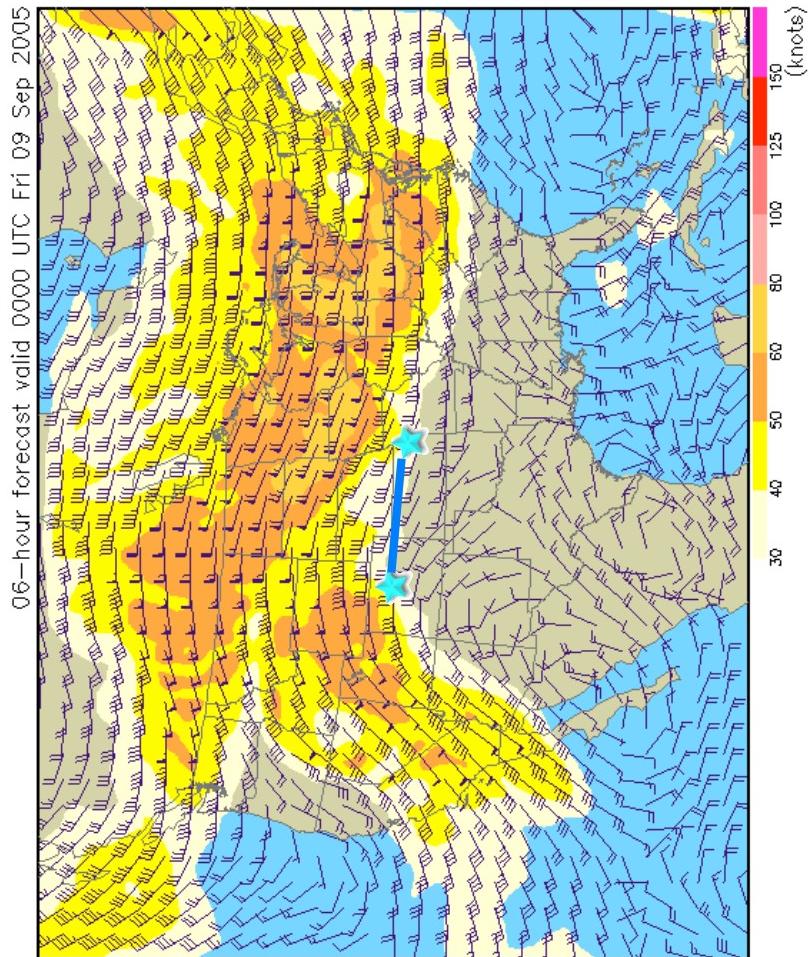
chart created at 1355 UTC Fri 09 Sep 2005

AIRMETs valid until 2000z/gth, SIGMETs expire at or before 1555z/gth



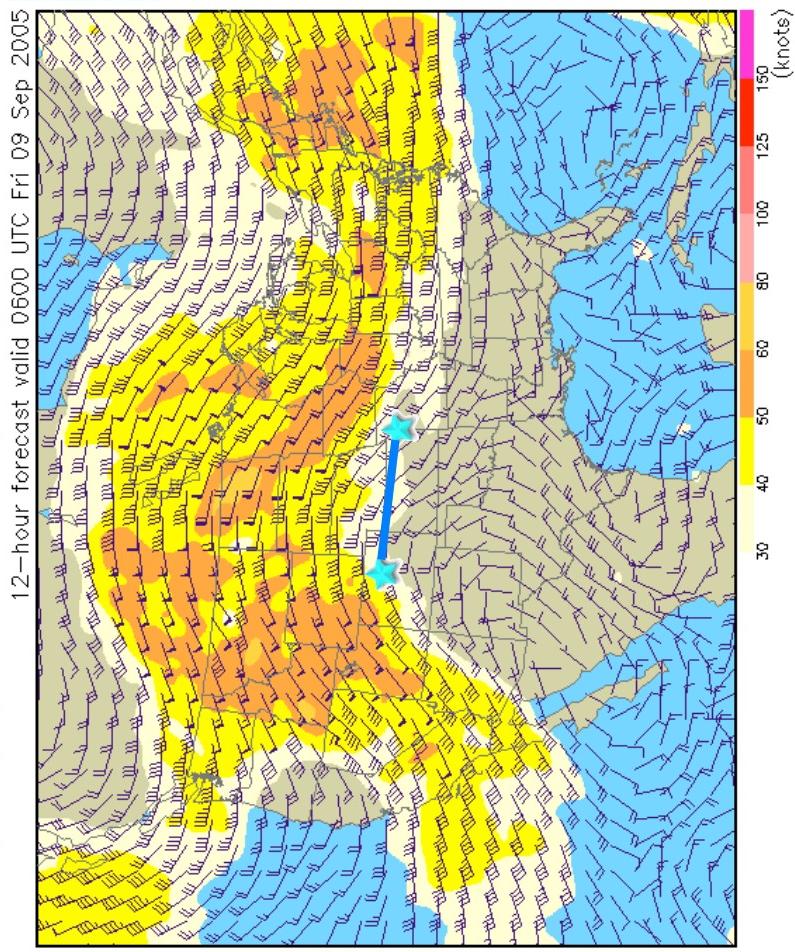
Wind Speed at FL480 at 0000
UTC 9 September 2005:

Wind speed (kts) at 48,000 ft MSL (125 mb)



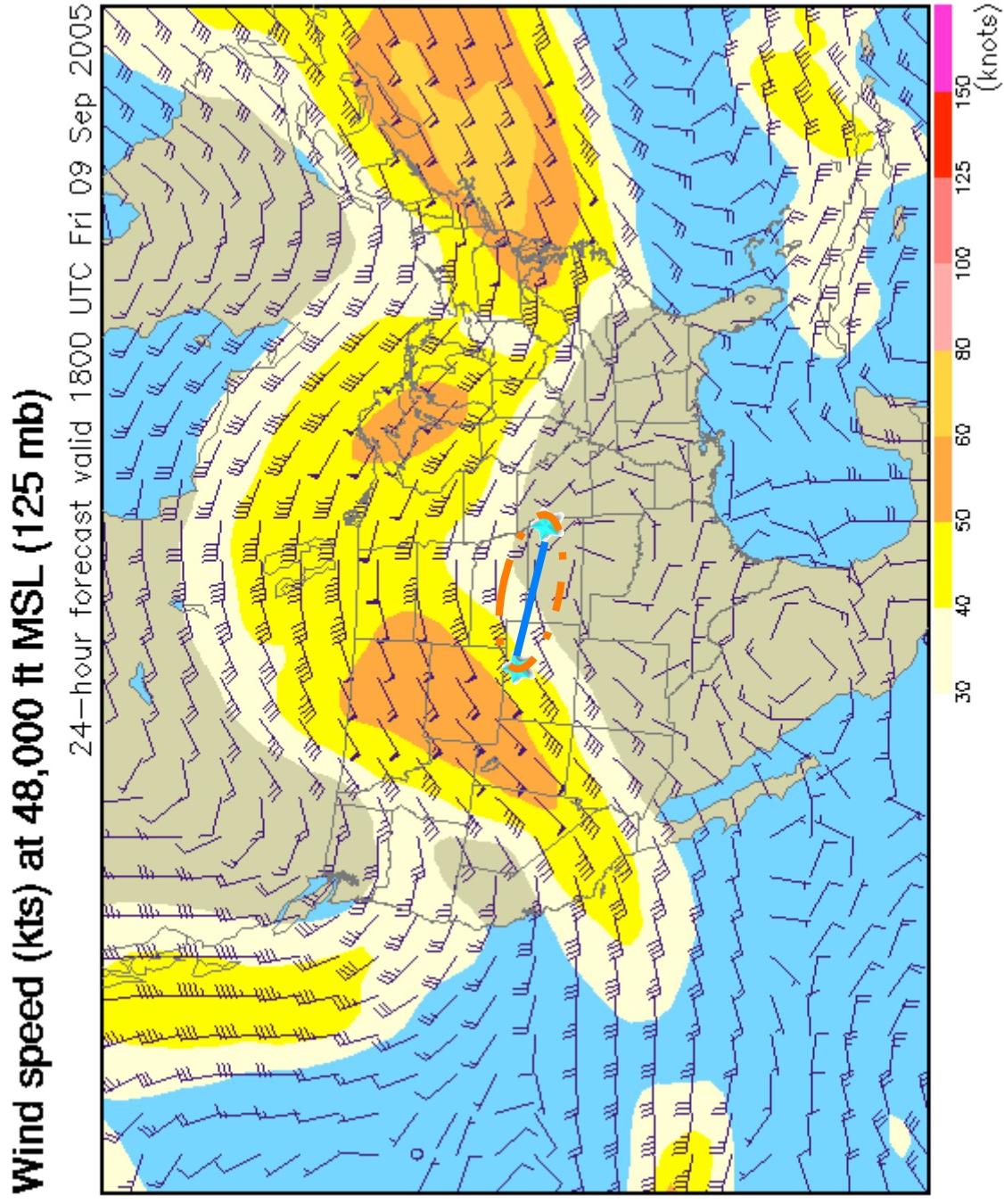
The winds for this portion of flight
decrease from 40 to 30 kts from the
northwest as the flight moves toward
Kansas City.

Wind speed (kts) at 48,000 ft MSL (125 mb)



Wind Speed at FL480 at 0600
UTC 9 September 2005:

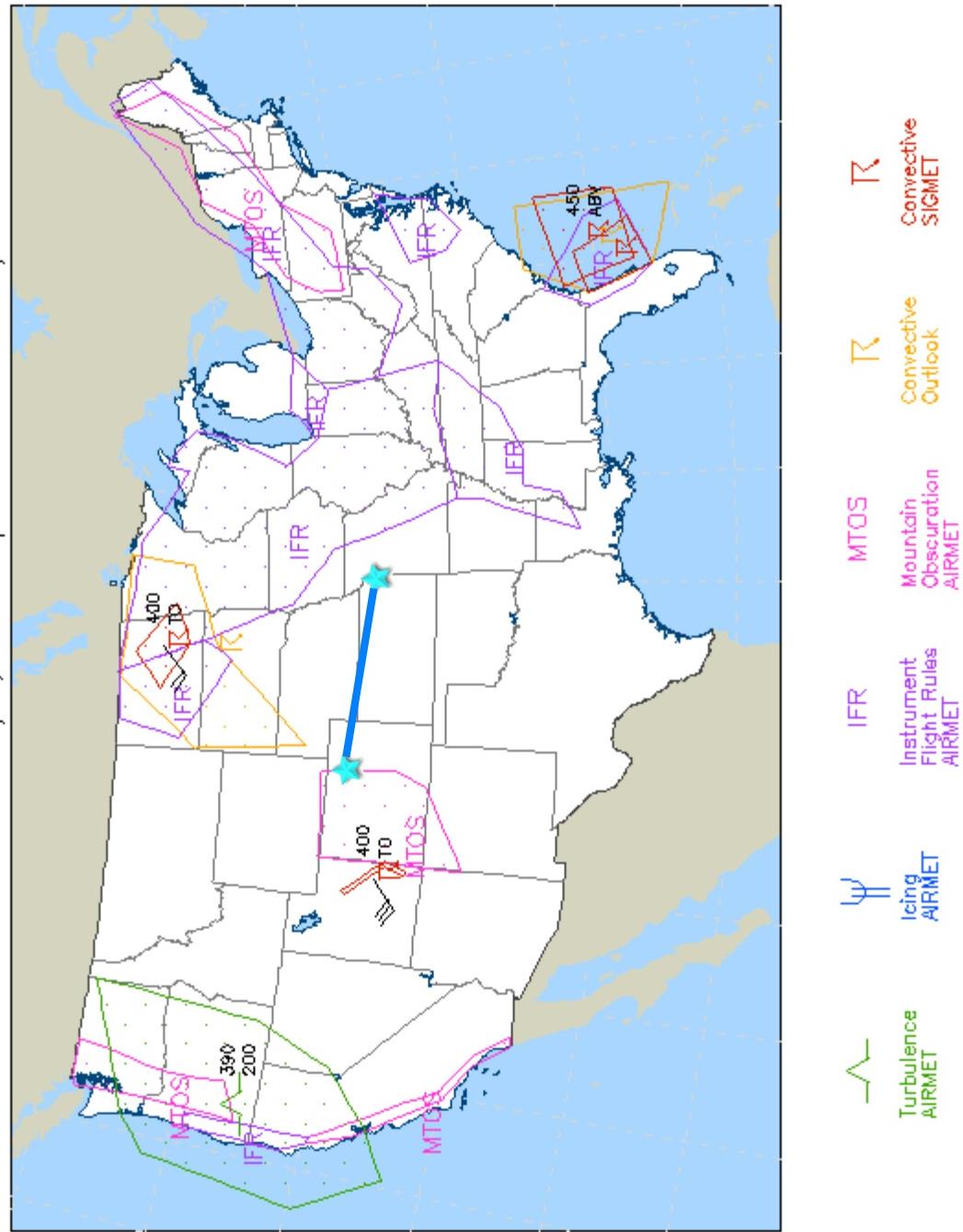
Wind Speed Chart at FL480 for
18UTC on 9 September 2005:



All active AIRMETs and SIGMETs for the continental U.S. as of 1255 UTC on 9 September 2005:

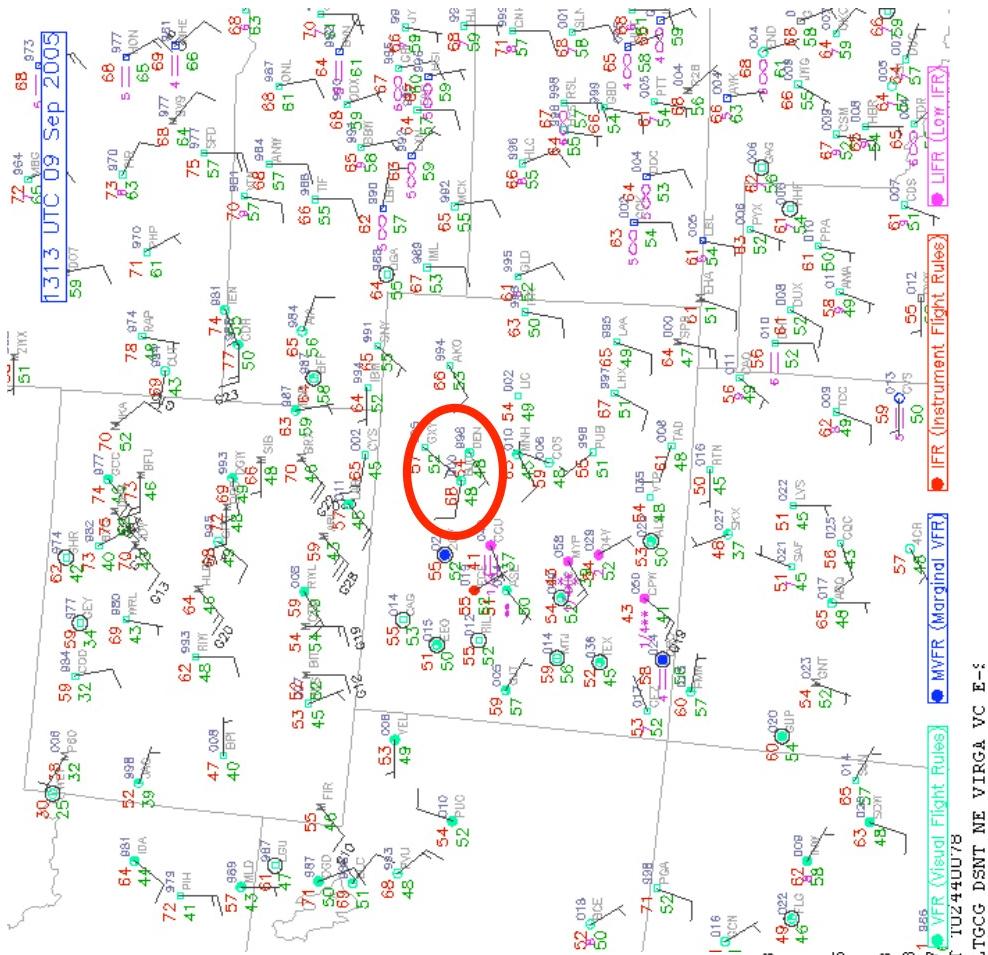
All active AIRMETs and SIGMETs

chart created at 1255 UTC Fri 09 Sep 2005
AIRMETS valid until 1400Z/9th, SIGMETs expire at or before 1455Z/9th



There is a mountain obscuration AIRMET for the Denver area.

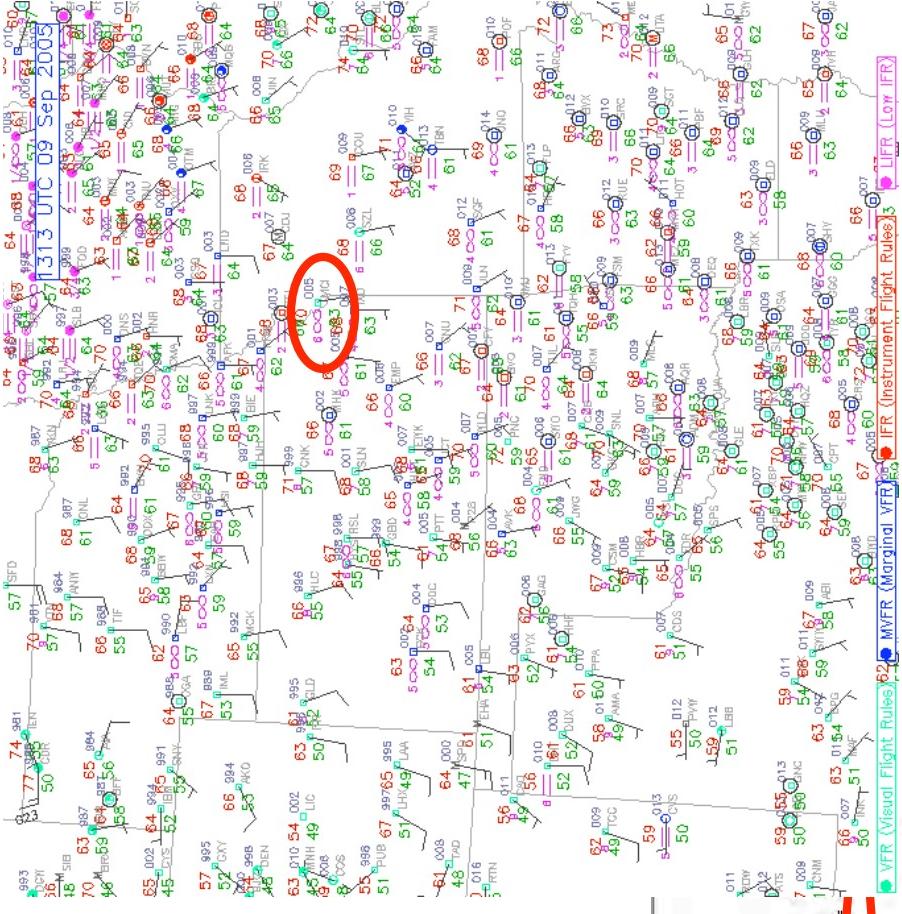
METAR for the Denver area at approximately 1300 UTC on 9 September 2005:



Observations for DENVER, CO (DEN)

| KDEN 091253Z 2400Z | 10SM FEN060 SCT120 18/09 A2998 RMK A02 SLPD071 T01780089 | ✓ | ✓ MVFR (Marginal VFR) |
|--------------------------|--|---|---------------------------------|
| KDEN 091253Z 2400Z | 10SM FEN050 SCT120 19/09 A2997 RMK A02 SLPD072 T01780089 | ✓ | ✓ VFR (Visual Flight Rules) |
| KDEN 091053Z 1800Z | 10SM SCT120 SCT220 16/08 A2997 RMK A02 SLPD061 T01610083 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090853Z 21013KT | 10SM SCT120 SCT220 21/09 A2998 RMK A02 SLPD059 T02220089 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090753Z 22010KT | 10SM FEN090 BKN120 22/09 A2999 RMK A02 SLPD066 T022280094 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090653Z 22013KT | 10SM SCT090 BKN120 23/09 A3003 RMK A02 SLPD071 T02280094 40333 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090553Z 23013KT | 10SM SCT090 BKN120 BKN200 23/09 A3005 RMK A02 SLPD081 T02330008 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090453Z 24014KT | 10SM FEN090 BKN110 BKN200 24/08 A3005 RMK A02 SLPD083 T02440071 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090353Z 21010KT | 10SM FEN095 BKN120 BKN200 24/08 A3008 RMK A02 SLPD098 CB DSPI T02440071 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090253Z 00000KT | 10SM FEN080 SCT090CB BKN110 BKN200 24/08 A3007 RMK A02 SLPD097 OCNL LTGCG DSNT NE VIRGA VC E | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090153Z 00000KT | 10SM FEN080 SCT110 BKN130 BKN200 24/07 A3007 RMK A02 SLPD103 OCNL LTGCG DSNT NE VIRGA I | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090053Z 2900Z | 10SM FEN080 SCT110 BKN130 BKN200 28/06 A3006 RMK A02 SLPD104 OCNL LTGCG DSNT NE VIRGA II | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090040Z 3000Z | 10SM FEN07KT 10SM SCT090CB BKN110 BKN200 28/07 A3006 RMK A02 SLPD105 OCNL LTGCG DSNT NE VIRGA III | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 090030Z 2800Z | 10SM SCT080 BKN130 BKN220 28/08 A3010 RMK A02 SLPD107 OCNL LTGCG DSNT S VIRGA DSNT I | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 082311Z 27012KT | 10SM FEN080 SCT110 BKN130 BKN220 29/07 A3006 RMK A02 SLPD106 T023112 VIRGA DSNT SE-S AND W TCI | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 082225Z 23010KT | 10SM TS FEN080B SCT095 SCT110 BKN130 BKN220 32/06 A3006 RMK A02 SLPD120 VIRGA DSNT S-W ACNL DSNT I | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 082230Z 19011G23KT | 10SM TS FEN080CB SCT055 SCT130 BKN130 BKN220 31/07 A3006 RMK A02 TSB24 SLP095 OCNL LTGCG VC E | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 082113Z 33000KT | 10SM SCT080 BKN130 BKN220 33/06 A3008 RMK A02 SLPD095 OCNL LTGCG DSNT NE-S VIRGA S AMI | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 0802053Z 32000G15KT | 10SM SCT080 BKN130 BKN220 32/08 A3010 RMK A02 SLPD107 OCNL LTGCG DSNT S VIRGA DSNT I | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081953Z 32000KT | 10SM FEN090 SCT130 BKN220 300V36 10SM FEN080 SCT110 BKN130 BKN220 31/07 A3006 RMK A02 SLPD112 VIRGA DSNT S-V | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081853Z 31000KT | 10SM FEN080 SCT110 BKN130 BKN220 31/08 A3015 RMK A02 SLPD120 VIRGA DSNT S-W ACNL DSNT I | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081753Z 24000KT | 10SM FEN120 BKN120 BKN200 19/11 A3020 RMK A02 SLPD149 T01940111 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081653Z 00000KT | 10SM FEN090 BKN130 BKN220 27/10 A3019 RMK A02 SLPD141 T02670100 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081553Z 27005KT | 10SM FEN090 SCT120 BKN220 24/12 A3020 RMK A02 SLPD143 ACNL DSNT W T02440117 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081453Z 29004KT | 10SM FEN100 BKN120 BKN200 23/10 A3020 RMK A02 SLPD144 ACNL DSNT SW-W T02330100 510002 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081353Z 24000KT | 10SM FEN120 BKN120 BKN200 19/11 A3020 RMK A02 SLPD149 T01940111 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081253Z 25000KT | 10SM BKN120 BKN200 15/11 A3019 RMK A02 SLPD148 T01670111 20200 20139 580002 | ✓ | ✓ IFR (Instrument Flight Rules) |
| KDEN 081153Z 2VR05KT | 10SM SCT120 BKN200 17/11 A3019 RMK A02 SLPD139 T01670111 20200 20139 580002 | ✓ | ✓ IFR (Instrument Flight Rules) |

**METAR for the
Kansas City area as of
1313 UTC on 9
September 2005:**



Observations for KANSAS, MO (MCD)

1133Z 8 Sep 2005 to 1253Z 9 Sep 2005

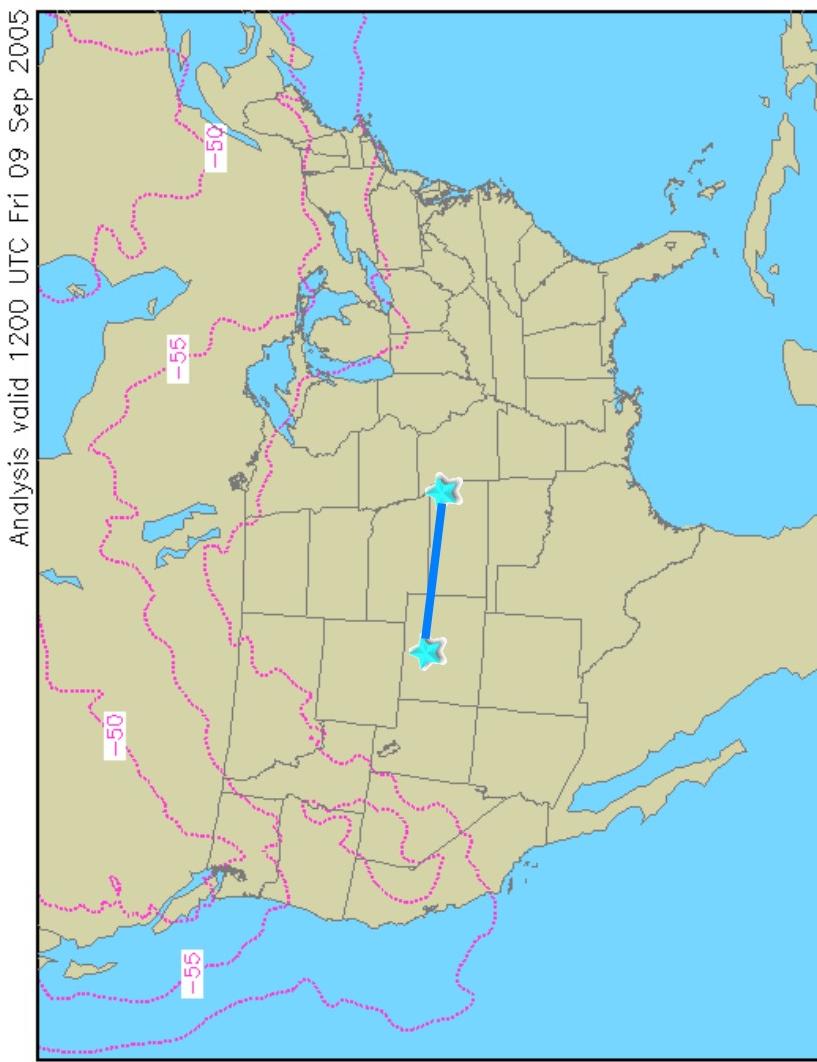
| STN | TIME | PMSL | ALTM | DIR | DEW RH | SPD | VIS | CLOUDS | Weather |
|-----|---------|-------------|-------|-----|--------|-----|-----|--------|---------|
| | | DD/HHMM hPa | inHg | F | F % | deg | kt | mile | |
| MCI | 09/1253 | 1016.7 | 30-05 | 70 | 63 | 78 | 170 | 5 | CLR |
| MCI | 09/1153 | 1016.4 | 30-04 | 69 | 62 | 78 | 190 | 3 | CLR |
| MCI | 09/1053 | 1015.9 | 30-03 | 69 | 62 | 78 | 180 | 6 | CLR |
| MCI | 09/0953 | 1015.5 | 30-02 | 69 | 62 | 78 | 180 | 6 | CLR |
| MCI | 09/0853 | 1015.4 | 30-02 | 70 | 62 | 76 | 190 | 6 | CLR |
| MCI | 09/0753 | 1015.4 | 30-02 | 71 | 62 | 73 | 190 | 8 | CLR |
| MCI | 09/0653 | 1015.3 | 30-02 | 73 | 62 | 68 | 200 | 9 | CLR |
| MCI | 09/0553 | 1015.5 | 30-02 | 74 | 63 | 69 | 190 | 10 | CLR |
| MCI | 09/0453 | 1015.4 | 30-02 | 72 | 64 | 76 | 180 | 8 | CLR |
| MCI | 09/0353 | 1015.6 | 30-02 | 73 | 64 | 73 | 170 | 8 | CLR |
| MCI | 09/0253 | 1015.5 | 30-02 | 75 | 65 | 46 | 200 | 10 | FEW150 |
| MCI | 09/0153 | 1015.4 | 30-02 | 75 | 65 | 71 | 200 | 14 | SCT150 |
| MCI | 09/0053 | 1015.1 | 30-01 | 80 | 65 | 66 | 200 | 12 | PEW150 |
| MCI | 08/2353 | 1016.0 | 30-04 | 81 | 67 | 62 | 220 | 3 | OVC095 |
| MCI | 08/2253 | 1015.8 | 30-03 | 84 | 66 | 55 | 190 | 8 | PEW070 |
| MCI | 08/2153 | 1016.0 | 30-02 | 73 | 60 | 67 | 200 | 9 | BKN110 |
| MCI | 08/2053 | 1016.3 | 30-02 | 75 | 66 | 46 | 200 | 10 | H |
| MCI | 08/1953 | 1017.0 | 30-07 | 86 | 66 | 51 | 200 | 12 | H |
| MCI | 08/1853 | 1017.7 | 30-09 | 84 | 68 | 59 | 190 | 11 | H |
| MCI | 08/1753 | 1018.5 | 30-11 | 79 | 66 | 65 | 200 | 8 | H |
| MCI | 08/1653 | 1019.2 | 30-13 | 80 | 67 | 64 | 200 | 9 | SCT110 |
| MCI | 08/1553 | 1020.0 | 30-16 | 77 | 69 | 77 | 140 | 5 | FEW080 |
| MCI | 08/1453 | 1020.5 | 30-17 | 73 | 68 | 84 | 240 | 6 | PEW017 |
| MCI | 08/1353 | 1019.6 | 30-14 | 75 | 68 | 79 | 190 | 4 | SCT075 |
| MCI | 08/1253 | 1019.3 | 30-14 | 74 | 67 | 79 | 170 | 4 | SCT075 |
| MCI | 08/1153 | 1019.2 | 30-13 | 70 | 66 | 87 | 160 | 5 | SCT095 |



Temperatures for the continental U.S. at FL480 for 1200 UTC on 9 September 2005:

**Temperatures at FL480
over the Denver/Kansas
City flight area are
approximately -60 degrees
Celsius.**

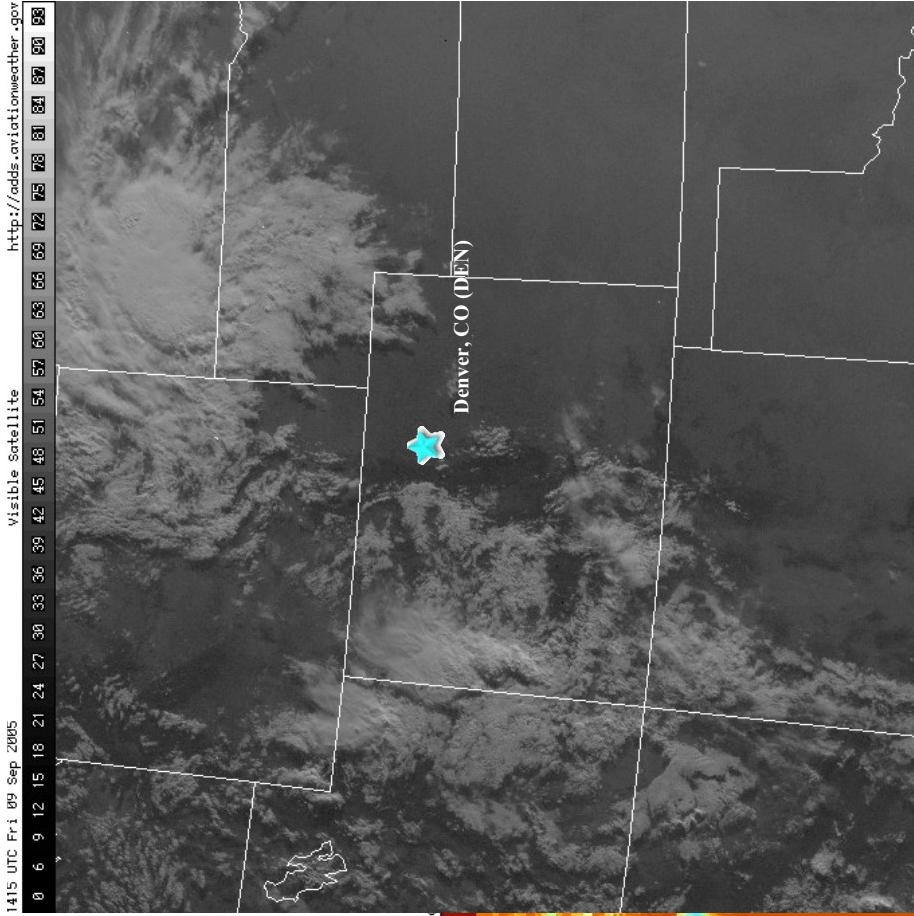
Temperature (°C) at 48,000 ft MSL (125 mb)



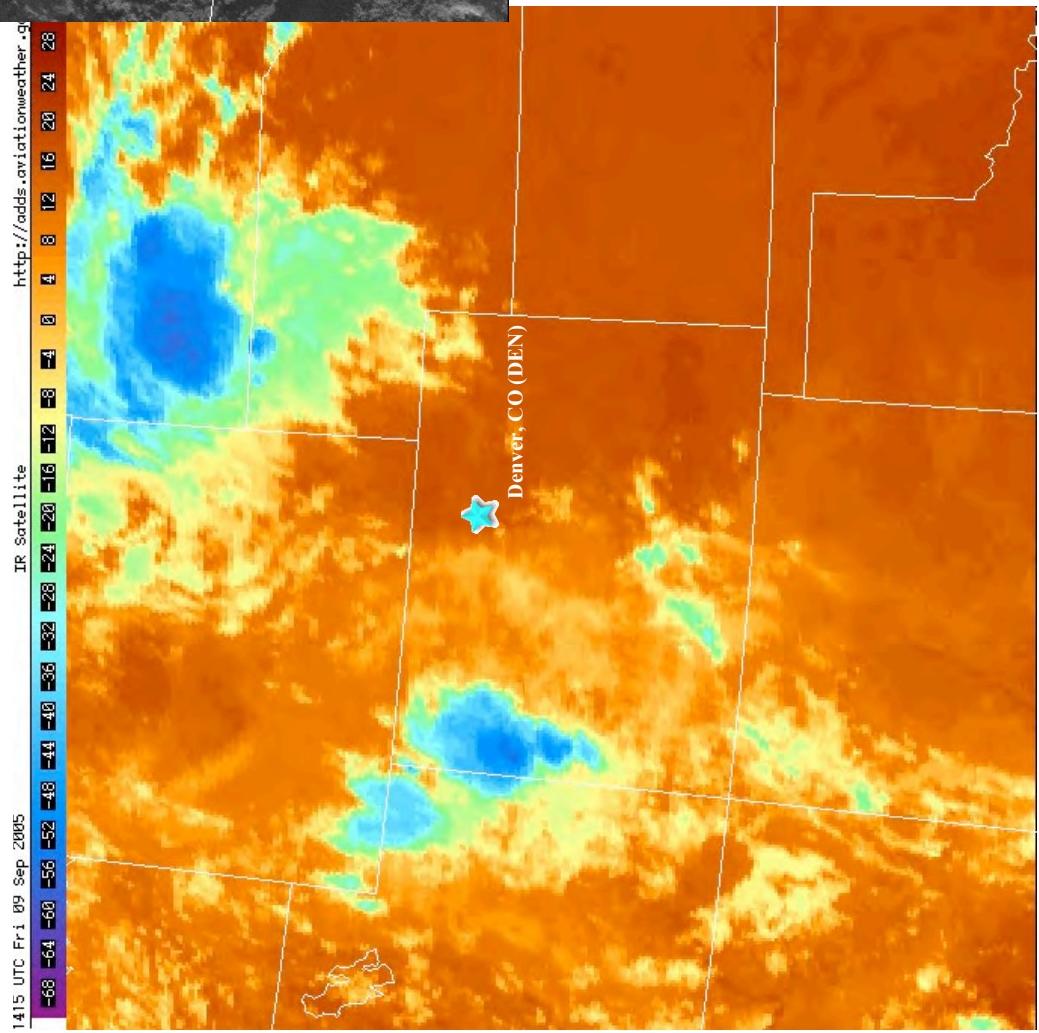
Visible Satellite Image over Denver, CO
at 1415 UTC on 9 September 2005:



There are thunderstorms along the
western border of Colorado. There
are also thunderstorms in western
Nebraska.

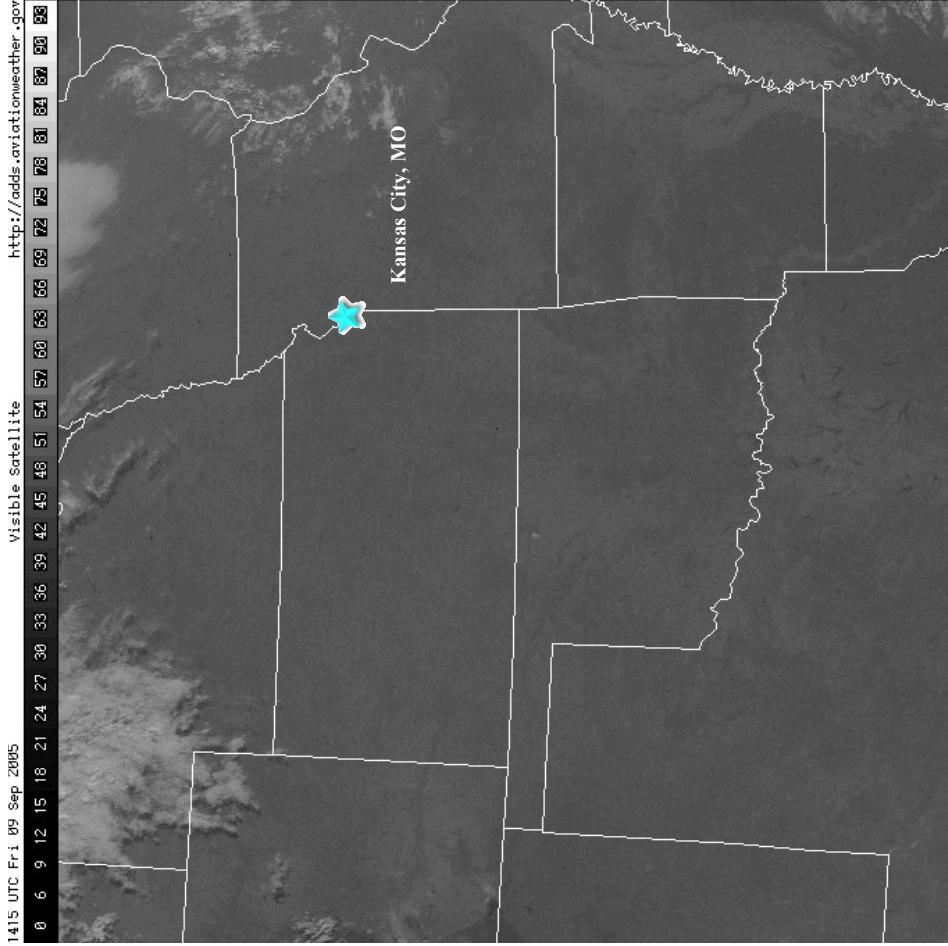


Infrared Satellite Imagery over
Denver, CO at 1415 UTC on 9
September 2005:



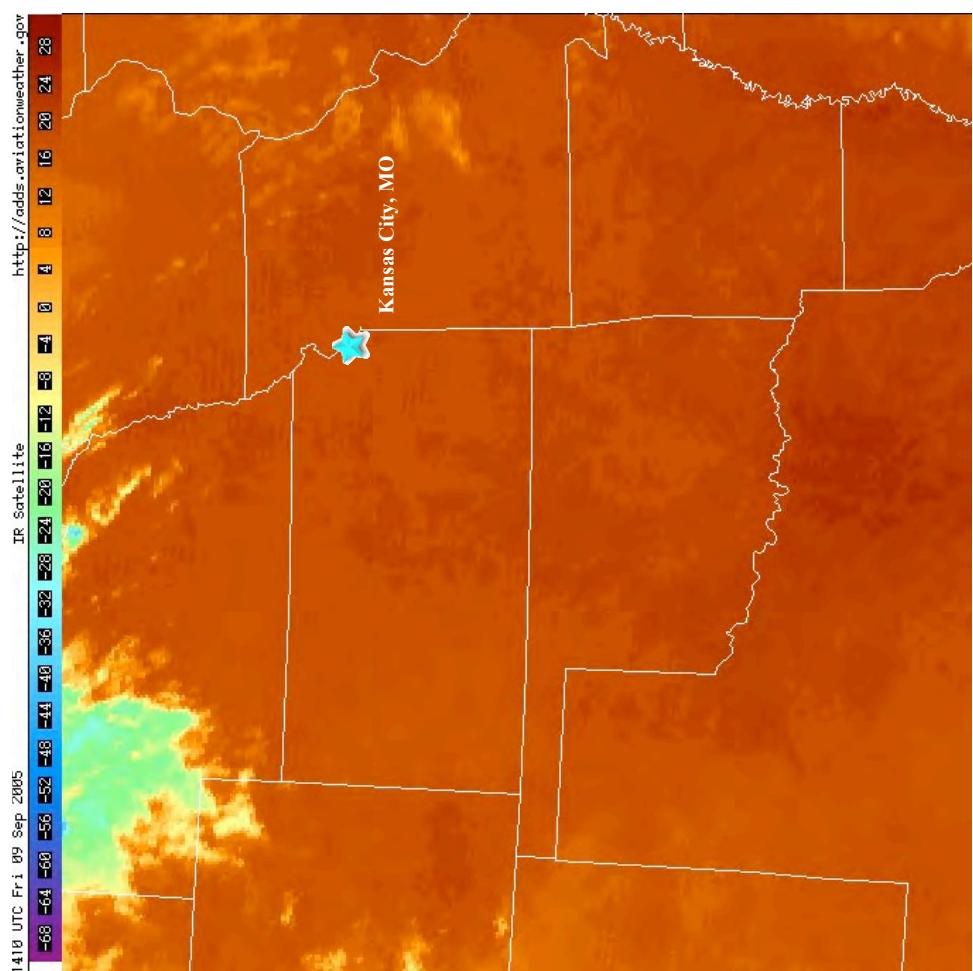
Visible Satellite Imagery over
Kansas City, MO at 1415 UTC
on 9 September 2005:

The skies are clear
over this area.

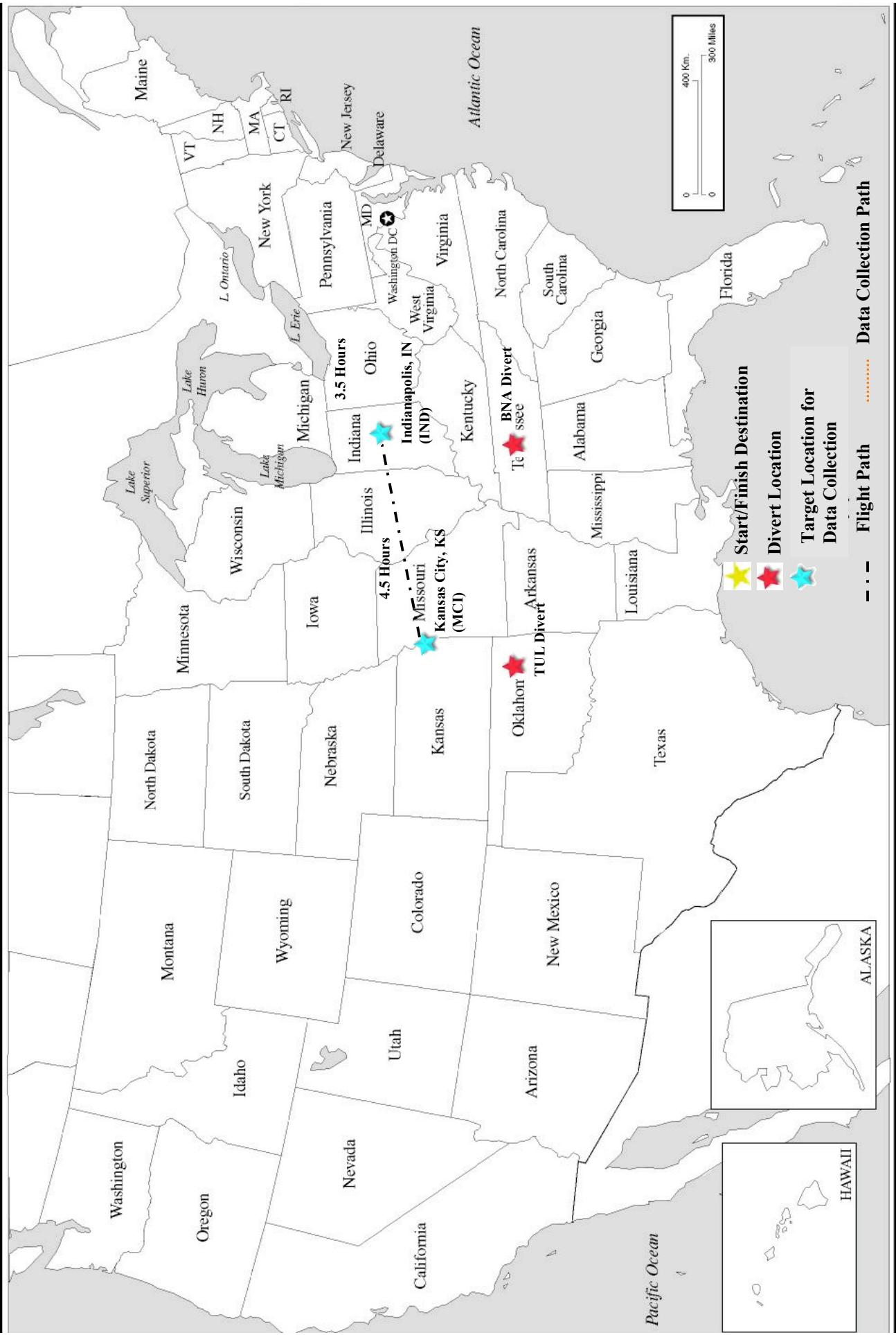


Clear skies are depicted
from this image as well as
the visible.

Infrared Satellite Imagery over
Kansas City, MO at 1410 UTC
on 9 September 2005:



Flight Scenario Second Leg



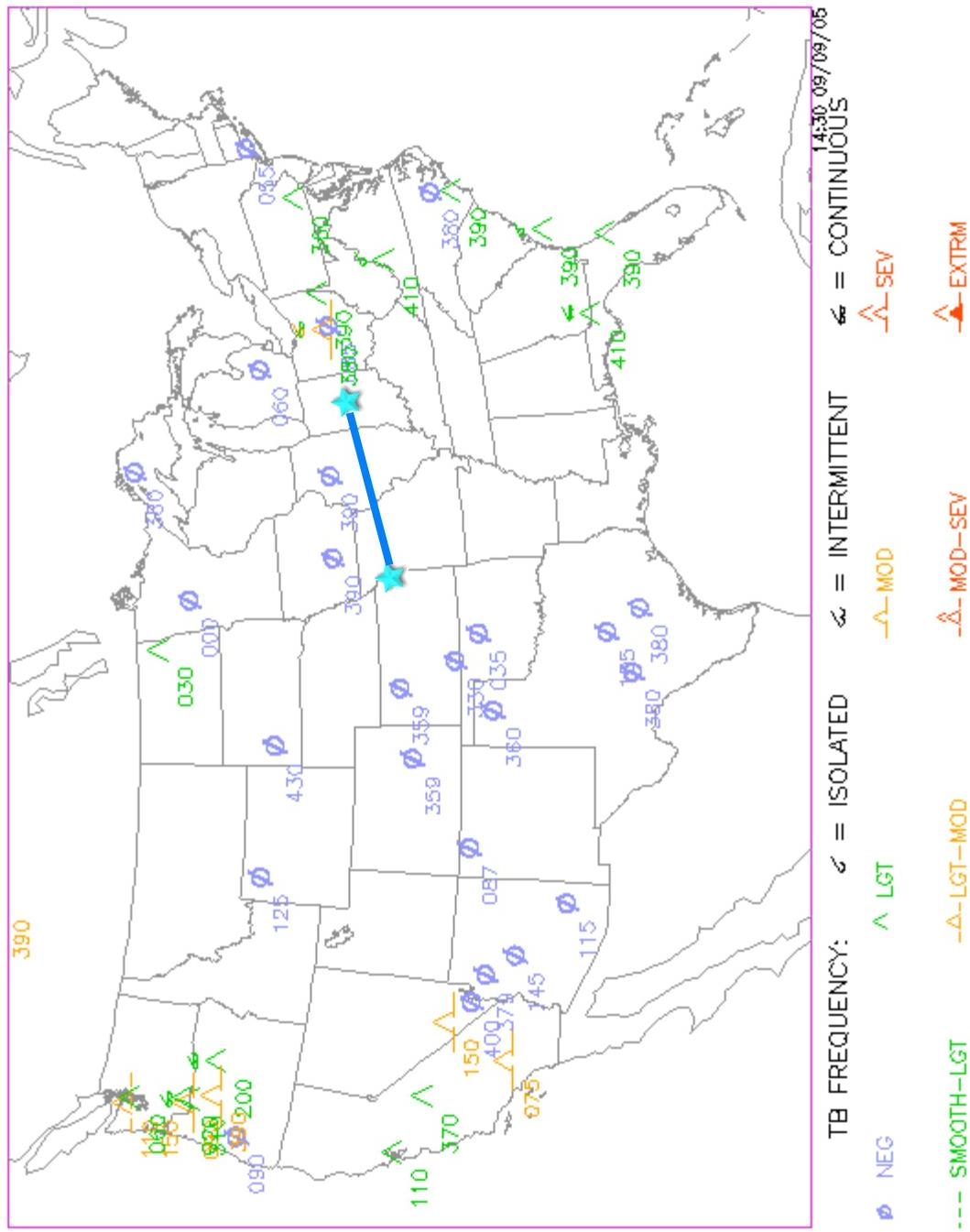
PIREP of turbulence for 1430 UTC
on 9 September 2005 across the
continental U.S.:

**Ending data collection
from Denver, CO to
Kansas City, MO.**

**Heading from Kansas
City to Indianapolis, IN,
arriving in Indianapolis
at 1900 UTC on 9
September 2005.**

Pilot Reports (PIREPs) of Turbulence

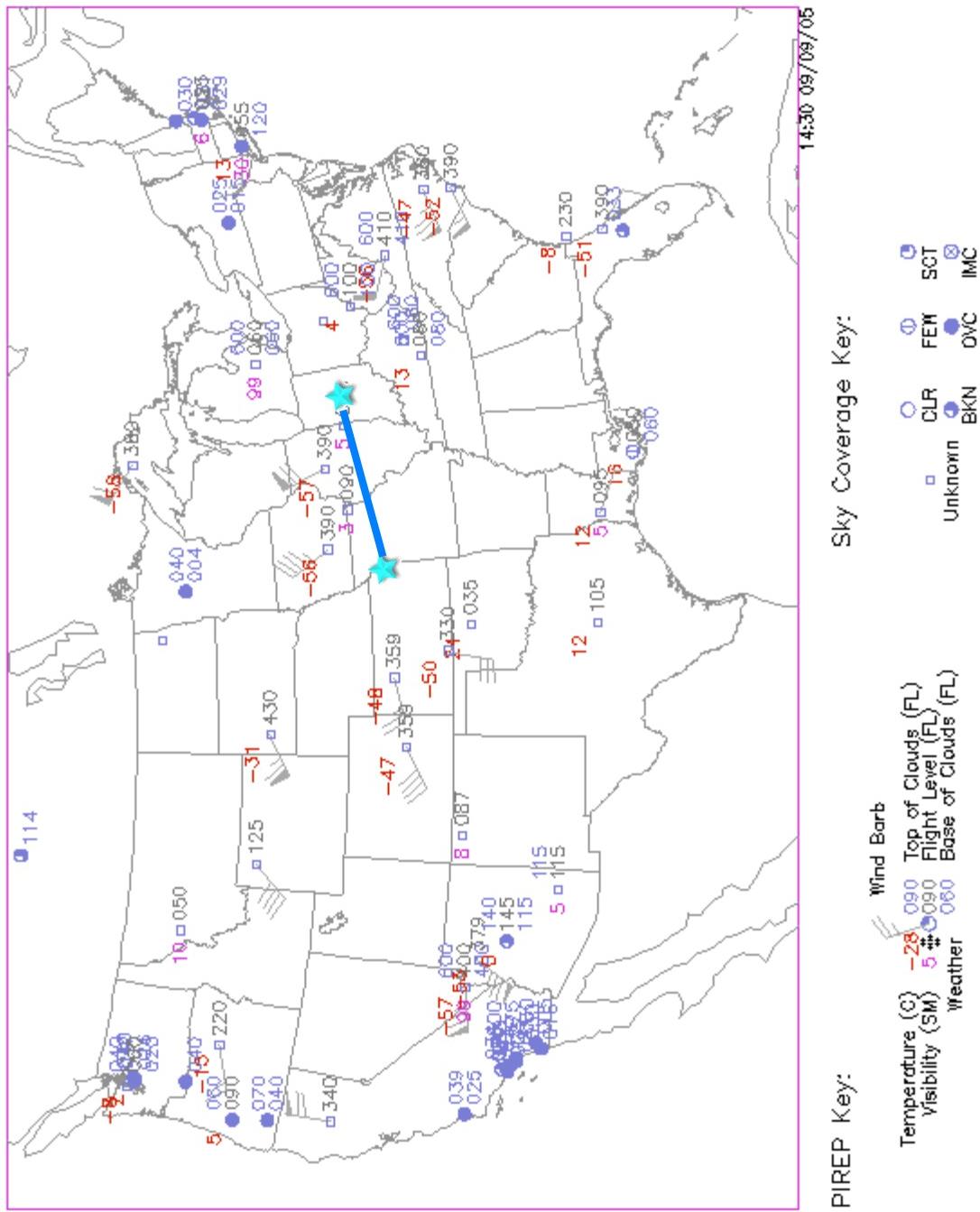
1259z – 1425z 09/09/05



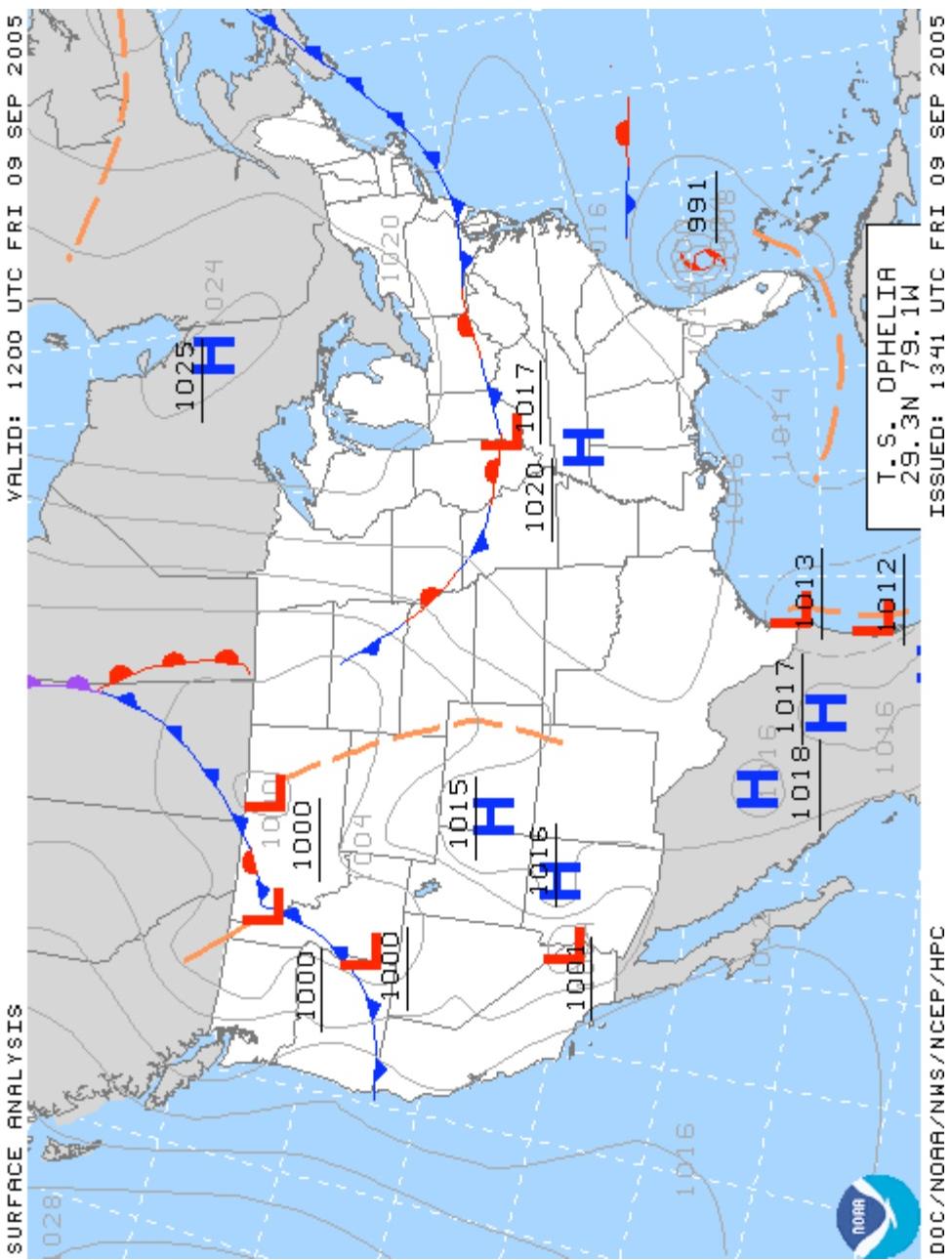
PIREP of Weather and condition for 1430 UTC 9 September 2005:

Pilot Reports (PIREPs) of Weather and Sky Conditions

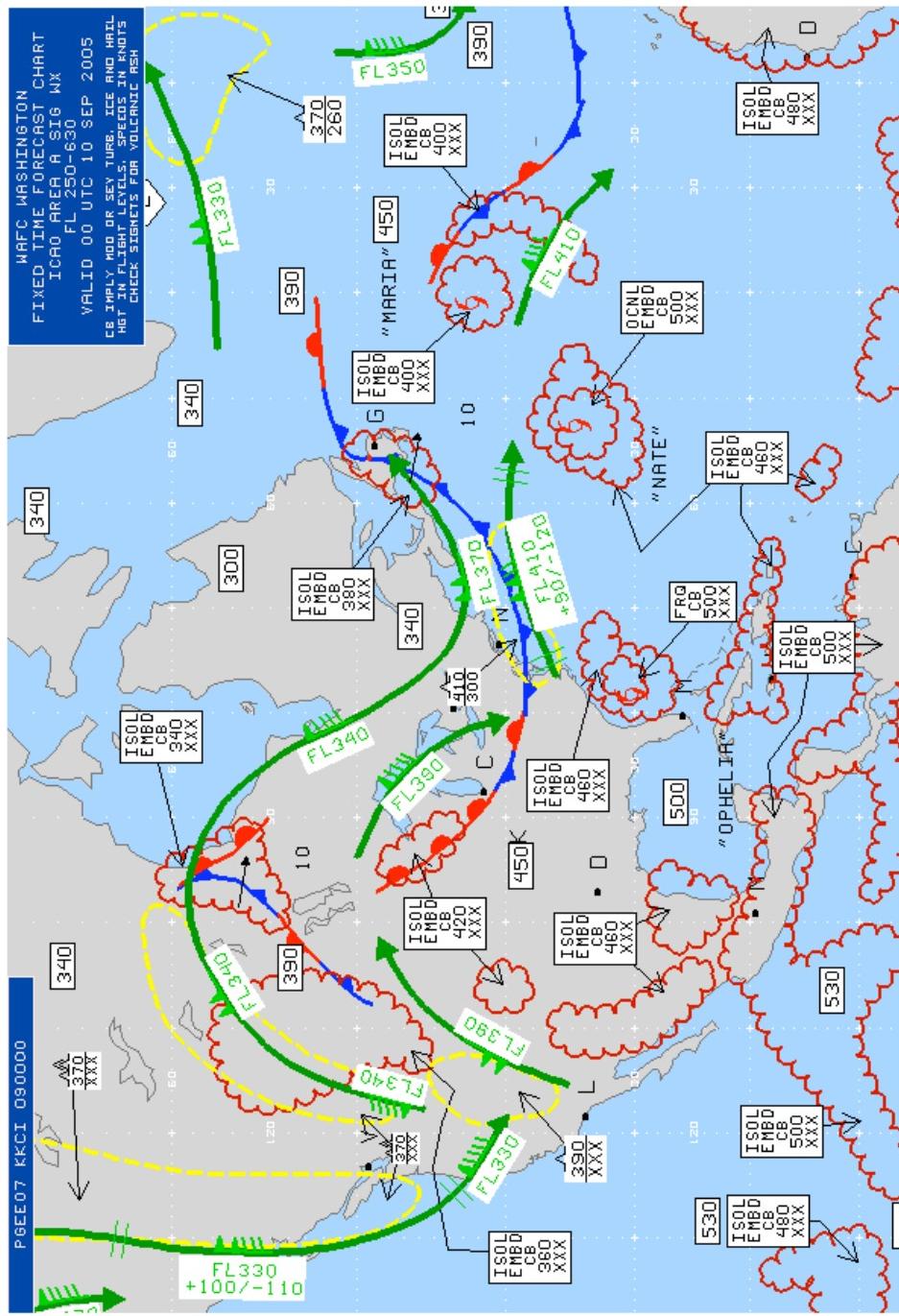
1258z – 1426z 09/09/05



**Surface Analysis Chart for
potential divers/contingency
management valid 1200 UTC on 9
September 2005:**



High-level fixed time forecast chart of North America and the U.S. valid 0000 UTC 10 September 2005:



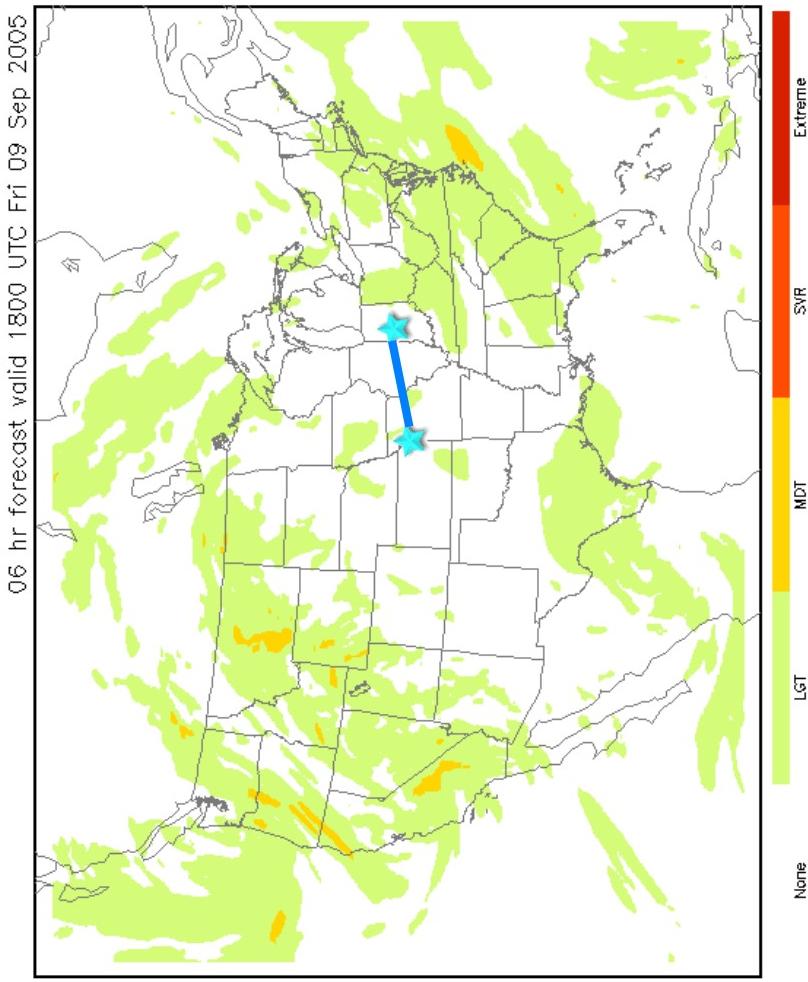
Current Time approximately 1451 UTC.

Flight status: en route from Kansas City, MO to Indianapolis, IN orbit point.

Estimated time of arrival: 1900 UTC

Turbulence of light intensity or less is expected along the flight path.

Turbulence forecast at FL450

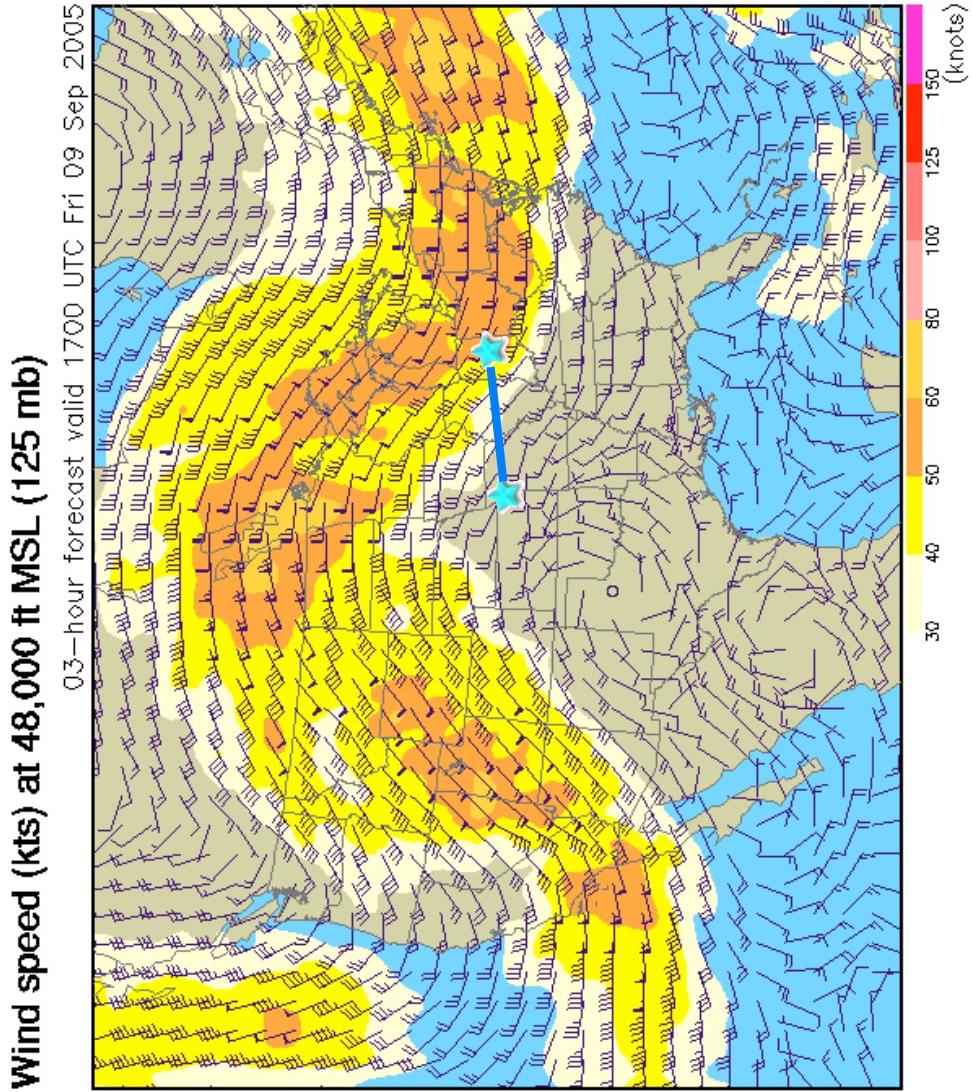


Turbulence AIRMETs (green) and SIGMETs (red)
chart created at 1355 UTC Fri 09 Sep 2005
AIRMETs valid until 2000z/9th, SIGMETs expire at or before 1555z/9th



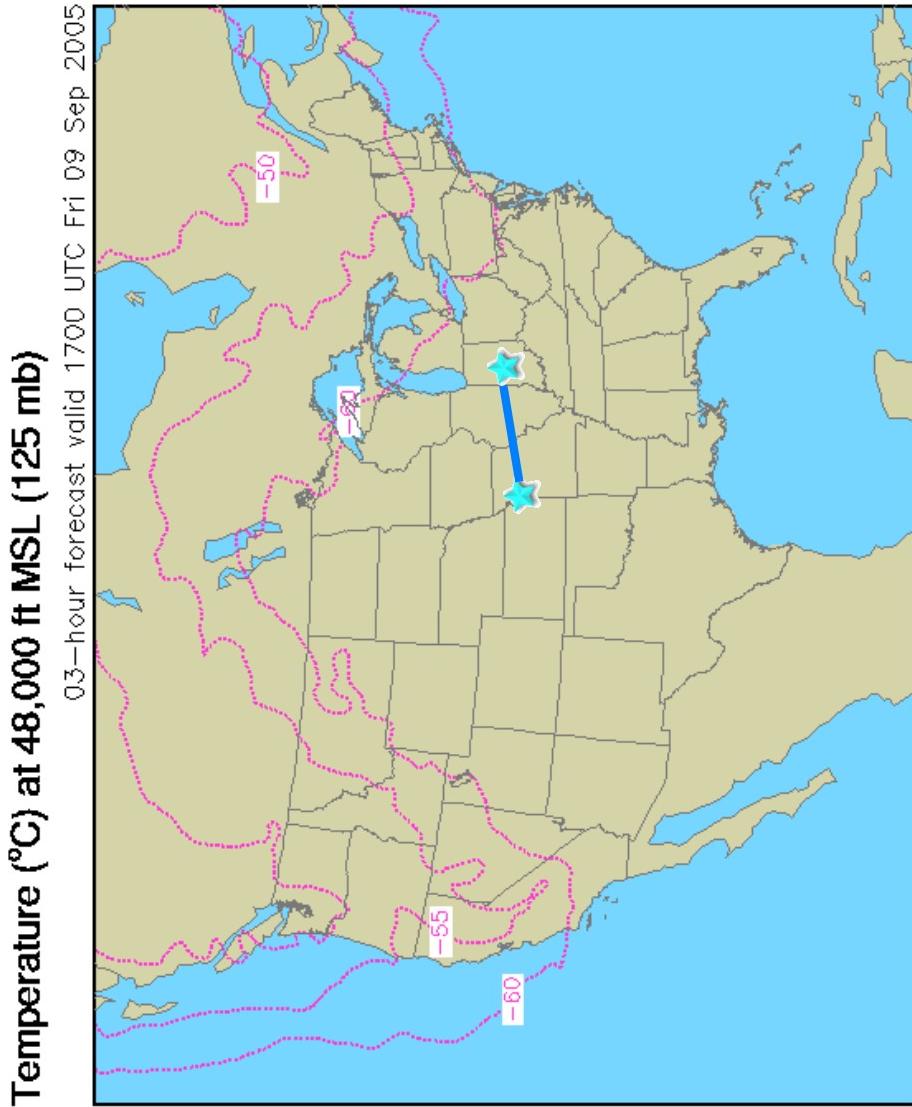
Turbulence AIRMETs and SIGMETs reported for 1400 UTC on 9 September 2005 valid until 2000 UTC on 9 September 2005.

Wind speed at FL480 valid until 1700 UTC on 9 September 2005:



Winds associated with a jet stream are over the Indianapolis area. The winds in this area are 45-55 knots from the northwest.

Temperature forecast for FL480
valid at 1700 UTC on 9
September 2005:

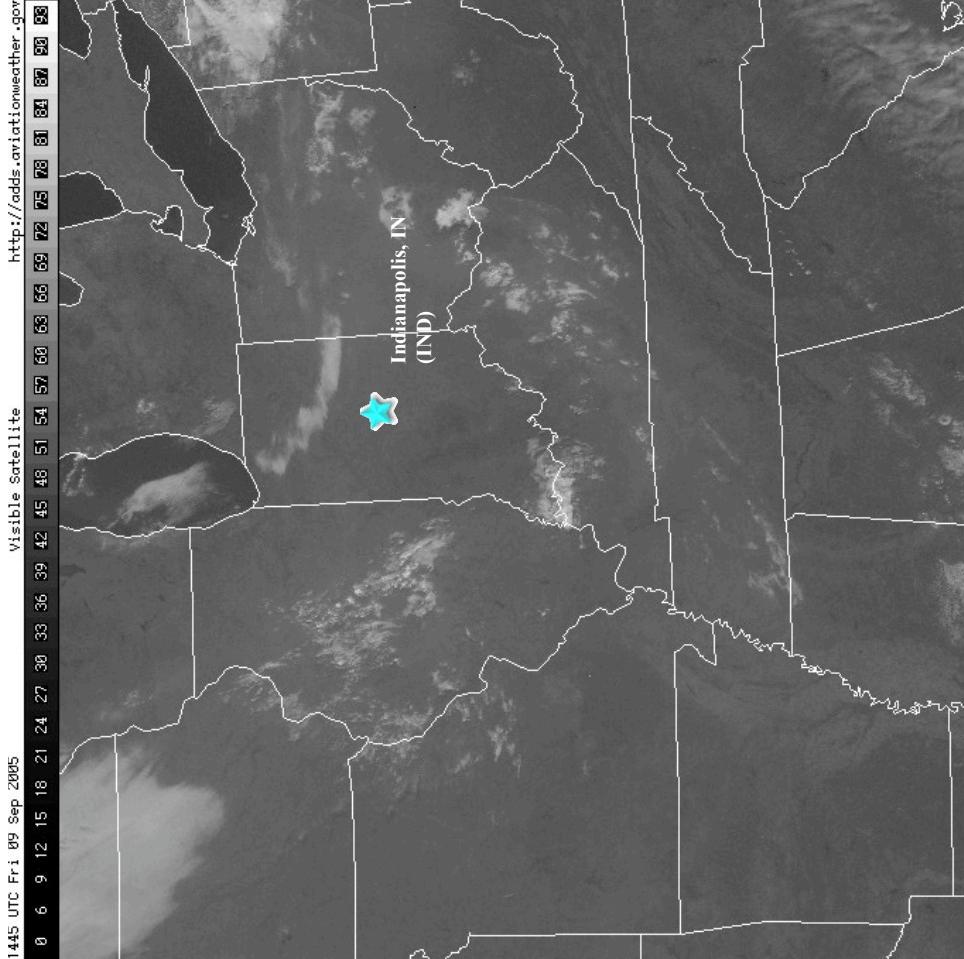


**Flight level temperature forecast
of -60°C or less for the entire
mission.**

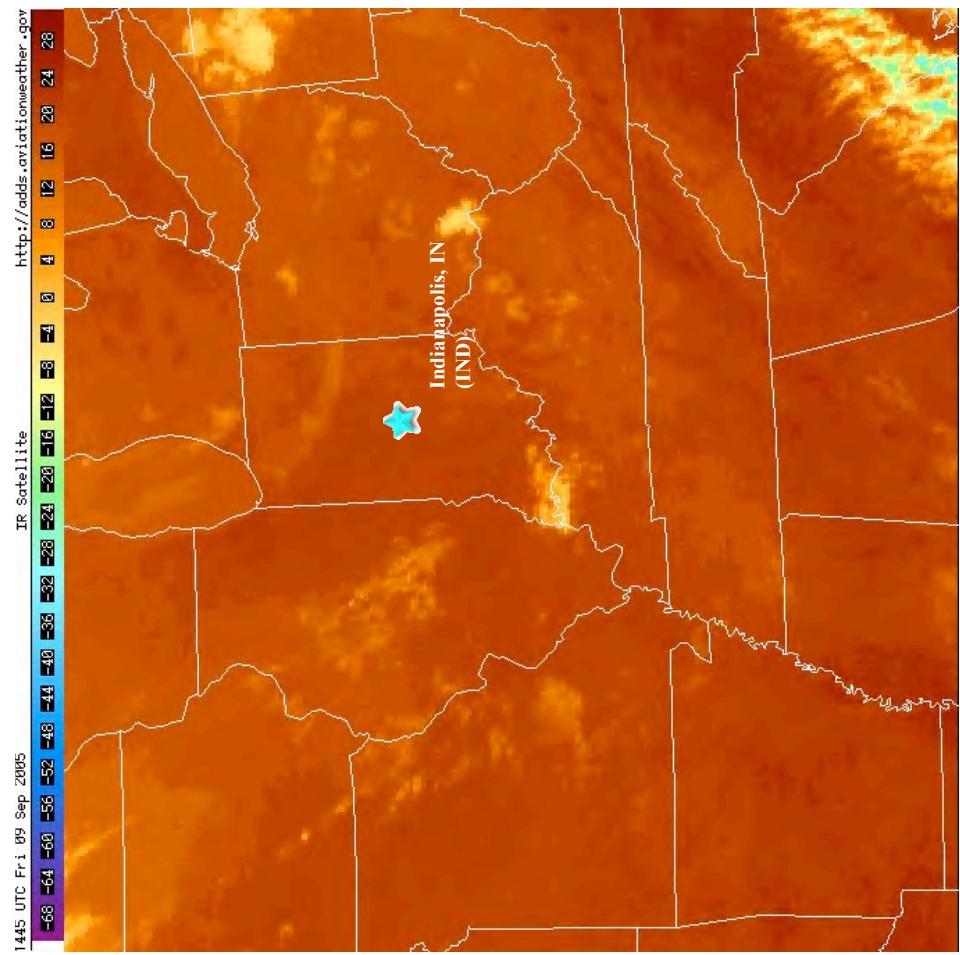
Visible Satellite Imagery of the
Indianapolis Area:



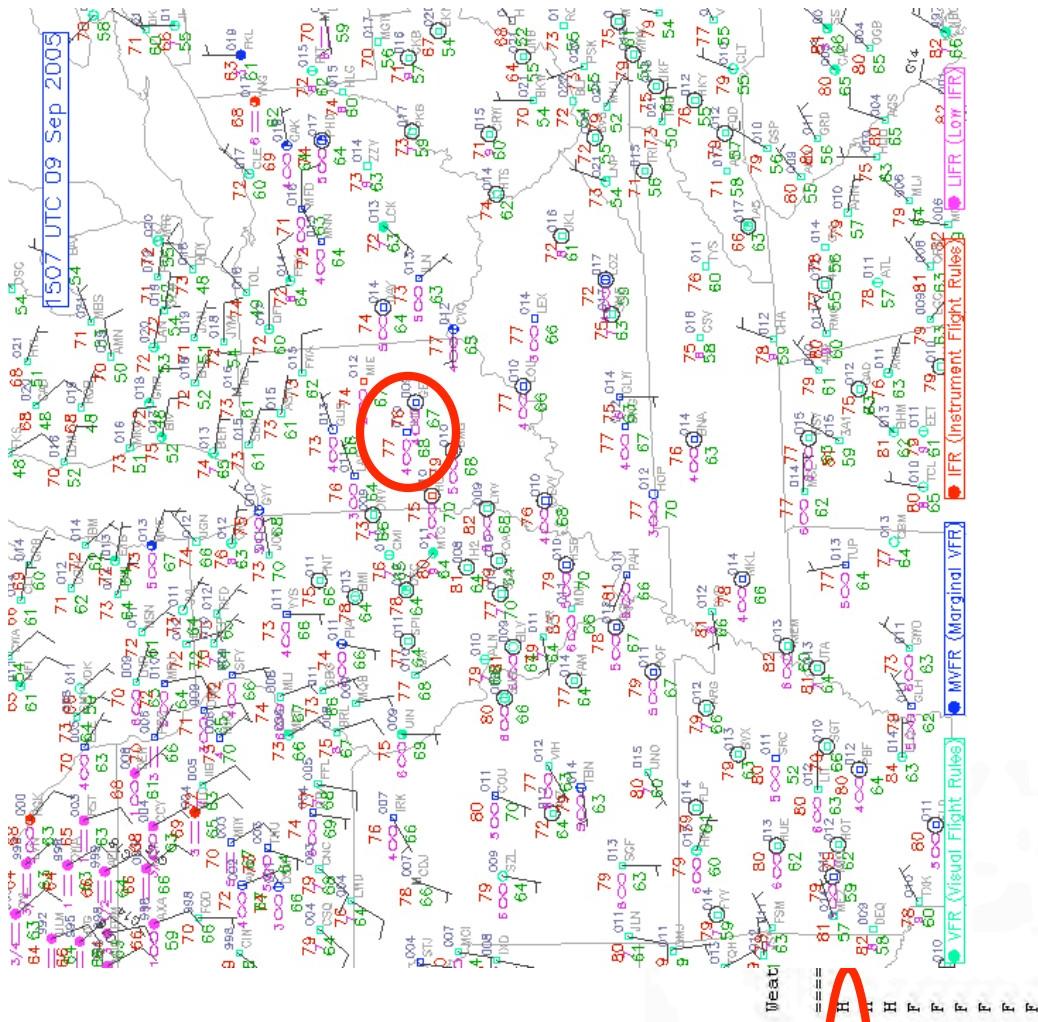
**There is no significant
weather in the area at
this time.**



Infrared Satellite Imagery of the
Indianapolis area:



METAR of the Indianapolis Area valid 1507 UTC on 9 September 2005:



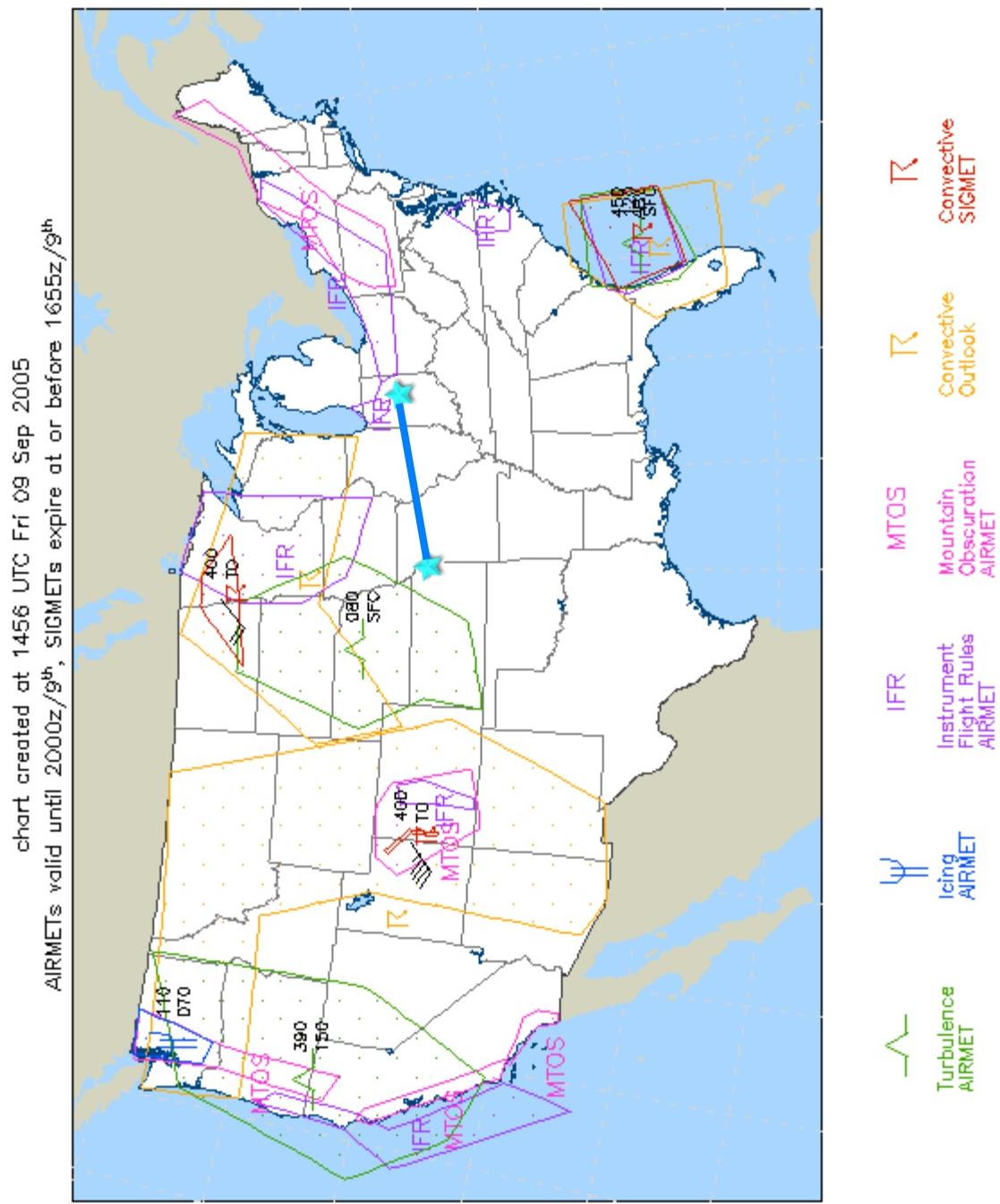
Observations for INDIANAPOLIS, IN (IND)

1455Z 8 Sep 2005 to 1555Z 9 Sep 2005

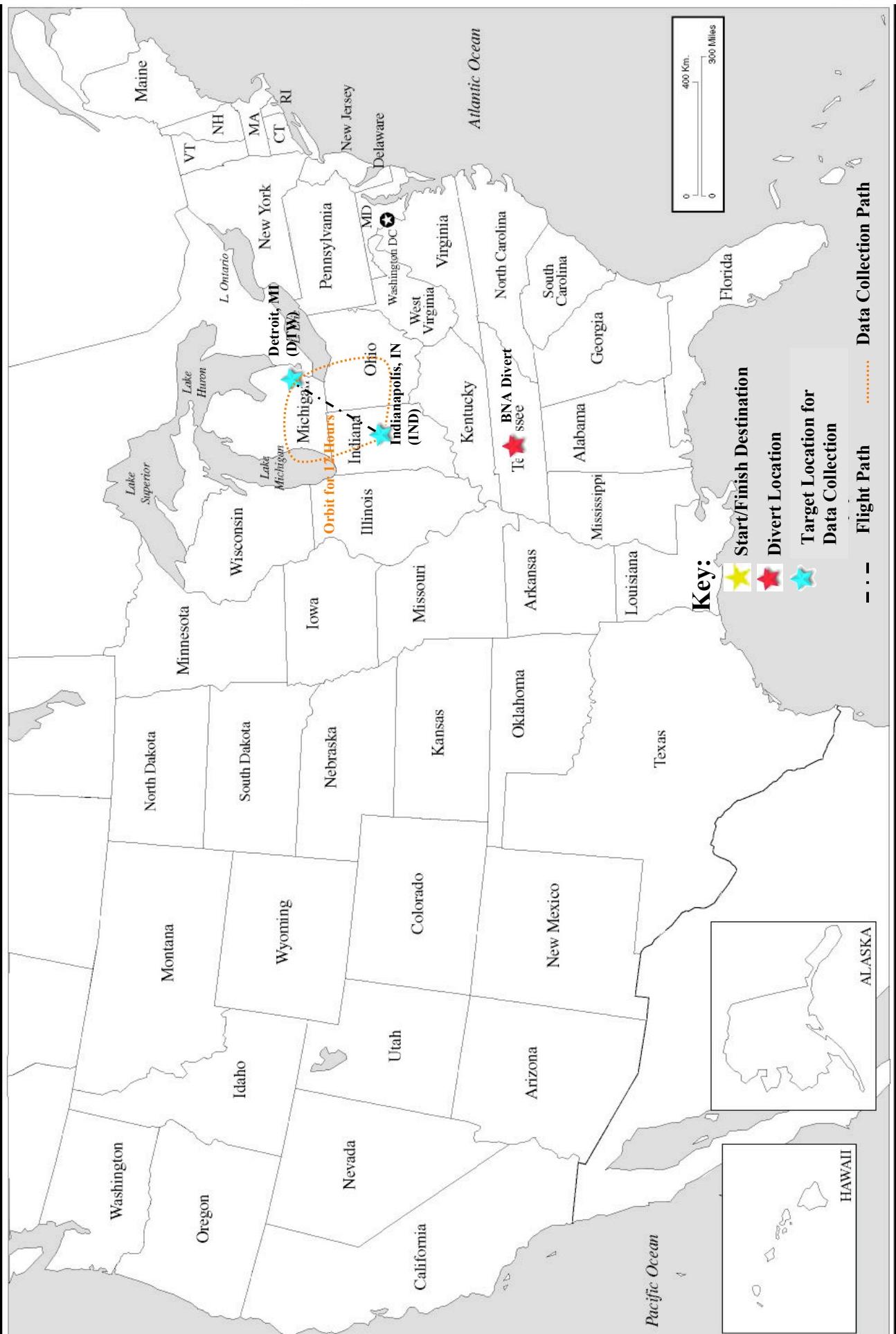
| STN | TIME | PMSL | ALTM | TMP | DW | RH | DIR | SPD | VIS | CLOUDS |
|-----|---------|-------------|-------|-----|----|----|-----|-----|------|--------|
| | | DD/HHRM hPa | inHg | F | F | % | deg | kt | mile | |
| IND | 09/1555 | 1018.7 | 30.10 | 82 | 67 | 60 | 4 | 5 | | CLR |
| IND | 09/1455 | 1018.7 | 30.10 | 77 | 68 | 74 | 3 | 4 | | CLR |
| IND | 09/1355 | 1018.6 | 30.10 | 73 | 67 | 74 | 3 | 3 | | CLR |
| IND | 09/1255 | 1018.6 | 30.10 | 71 | 67 | 87 | 190 | 4 | 2 | CLR |
| IND | 09/1155 | 1018.2 | 30.09 | 68 | 65 | 90 | 0 | 0 | | FEW220 |
| IND | 09/1055 | 1017.6 | 30.07 | 67 | 65 | 93 | 230 | 4 | 3 | FEW070 |
| IND | 09/0955 | 1016.9 | 30.05 | 68 | 66 | 93 | 190 | 5 | 3 | SCT200 |
| IND | 09/0855 | 1016.6 | 30.04 | 71 | 67 | 87 | 160 | 6 | 4 | BKN200 |
| IND | 09/0755 | 1016.7 | 30.04 | 73 | 67 | 87 | 170 | 4 | 4 | BKN150 |
| IND | 09/0655 | 1016.8 | 30.05 | 73 | 67 | 81 | 0 | 0 | | BKN220 |
| IND | 09/0555 | 1016.8 | 30.05 | 75 | 66 | 74 | 0 | 5 | | BKN150 |
| IND | 09/0455 | 1016.6 | 30.04 | 72 | 67 | 84 | 250 | 4 | 4 | OVC200 |
| IND | 09/0355 | 1016.5 | 30.04 | 73 | 68 | 84 | 240 | 3 | 5 | CLR |
| IND | 08/2155 | 1016.4 | 30.04 | 73 | 68 | 79 | 220 | 3 | 6 | FEW220 |
| IND | 08/2055 | 1016.3 | 30.03 | 82 | 66 | 58 | 220 | 10 | 6 | SCT050 |
| IND | 08/1955 | 1016.3 | 30.03 | 84 | 66 | 55 | 170 | 8 | 7 | SCT065 |
| IND | 08/1855 | 1016.4 | 30.04 | 81 | 67 | 51 | 230 | 4 | 8 | FEW060 |
| IND | 08/1755 | 1016.4 | 30.10 | 82 | 64 | 55 | 260 | 6 | 7 | SCT070 |
| IND | 08/1655 | 1019.1 | 30.12 | 81 | 64 | 56 | 270 | 5 | 6 | SCT070 |
| IND | 08/1555 | 1019.7 | 30.13 | 79 | 65 | 62 | 0 | 0 | | SCT070 |
| IND | 08/1455 | 1020.0 | 30.14 | 76 | 64 | 67 | 230 | 7 | 5 | CLR |

All active AIRMETs and SIGMETs valid at 1500 UTC and until UTC on 9 September 2005:

**There are no valid
AIRMETs and
SIGMETs for this
leg of the flight.**



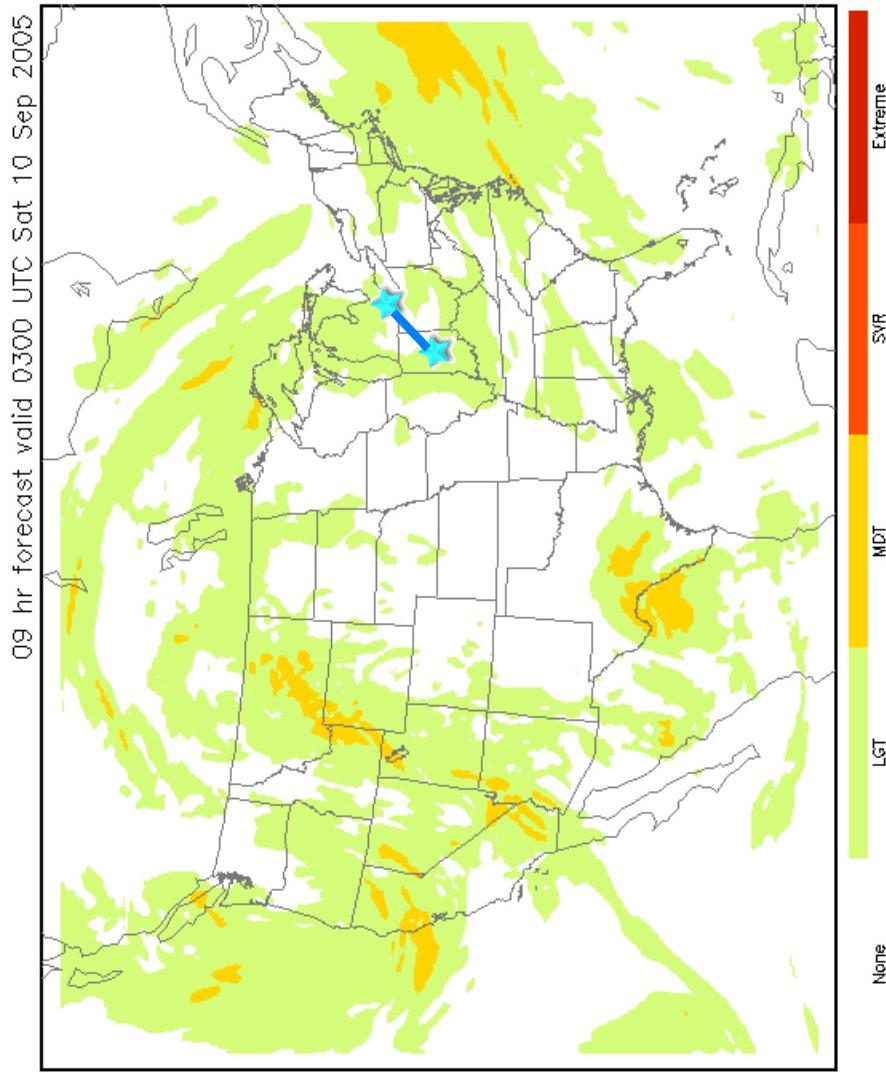
Flight Scenario Second Orbit Area



**Arrived at Indianapolis, IN
headed to Detroit, MI:**

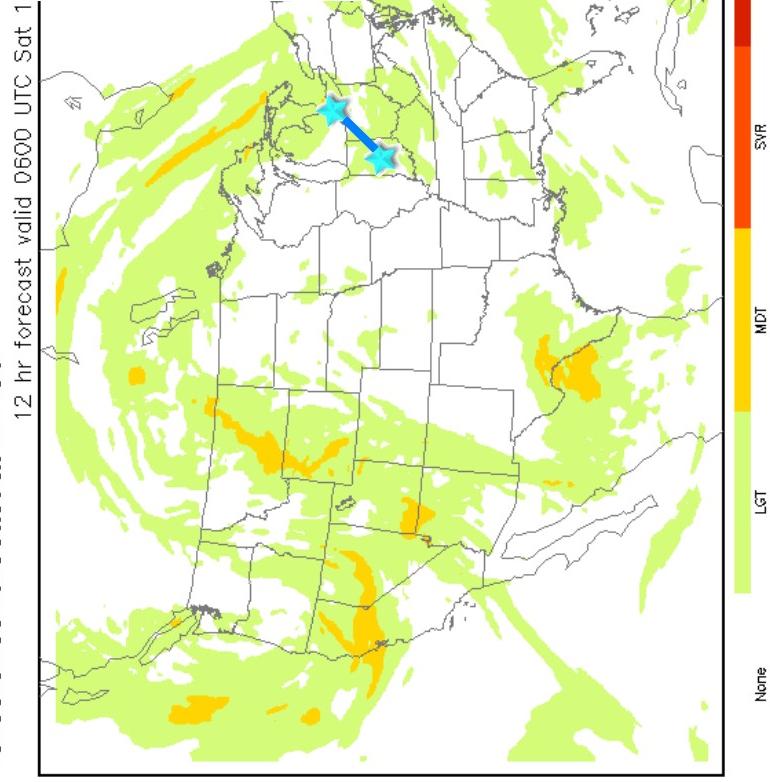
**Estimated time of arrival in
Detroit, MI is 2230 UTC on 9
September 2005**

Turbulence forecast at FL450

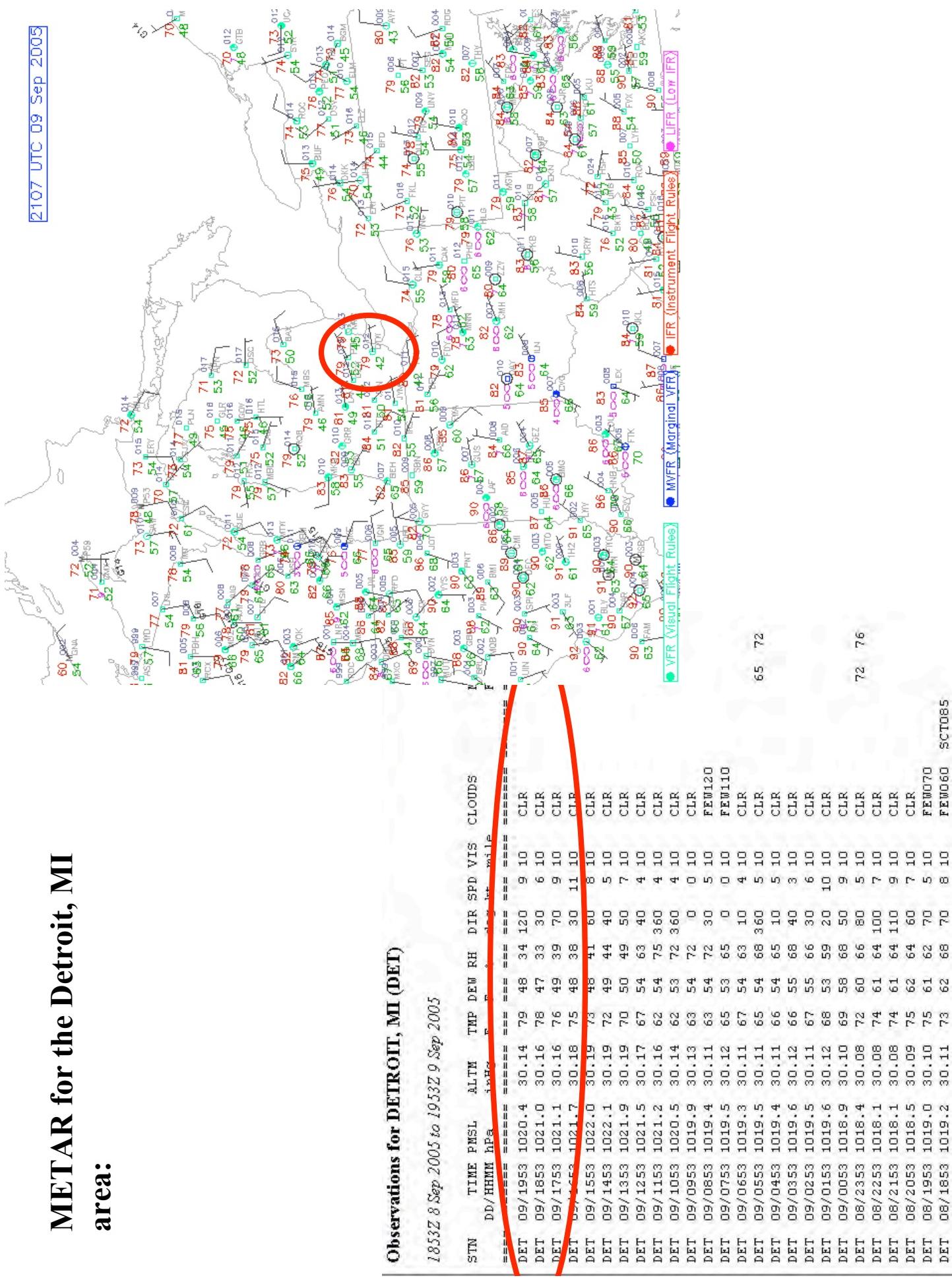


**Turbulence of light
intensity or less is
expected along the flight
path.**

Turbulence forecast at FL450

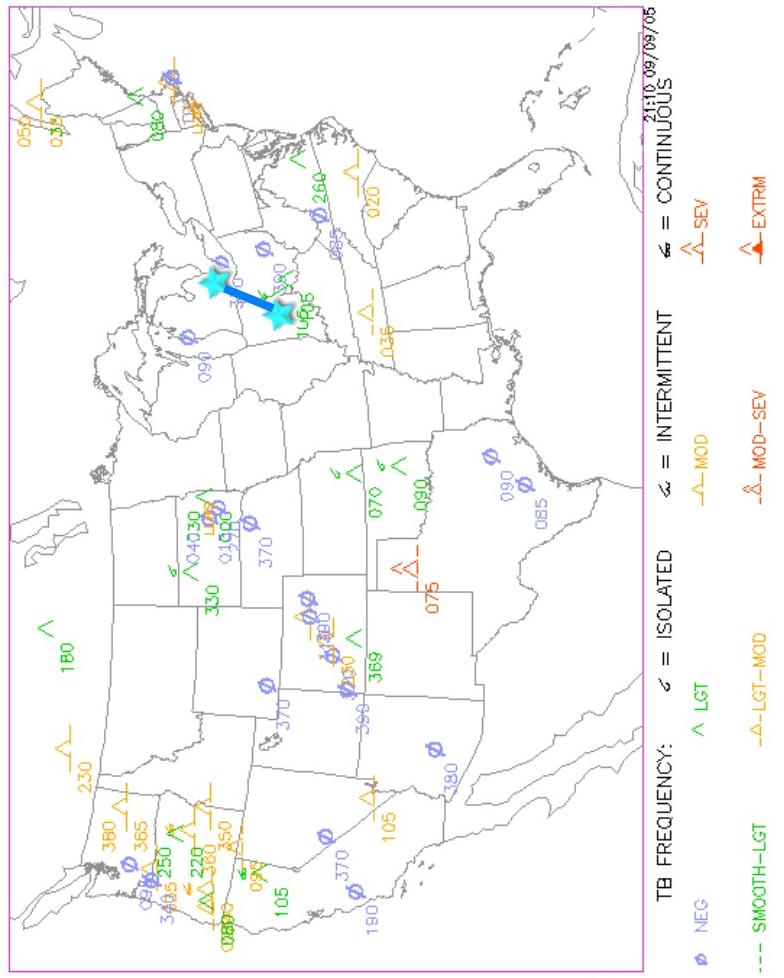


METAR for the Detroit, MI area:



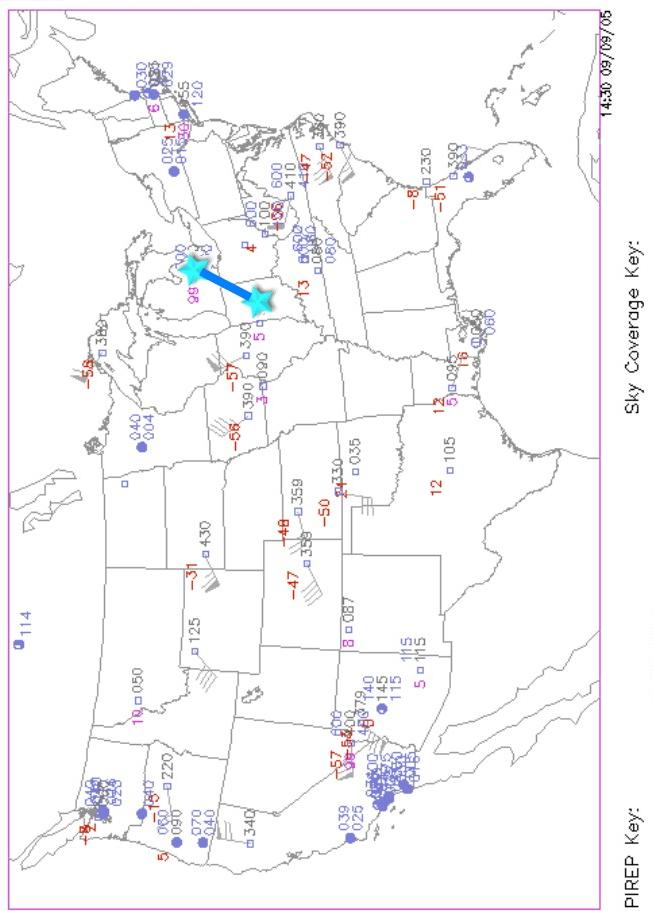
PIREPs summarizing weather and sky conditions over the contiguous United States:

Pilot Reports (PIREPs) of Turbulence
1935z - 2101z 09/09/05



Pilot Reports (PIREPs) of Weather and Sky Conditions

1258z - 1426z 09/09/05



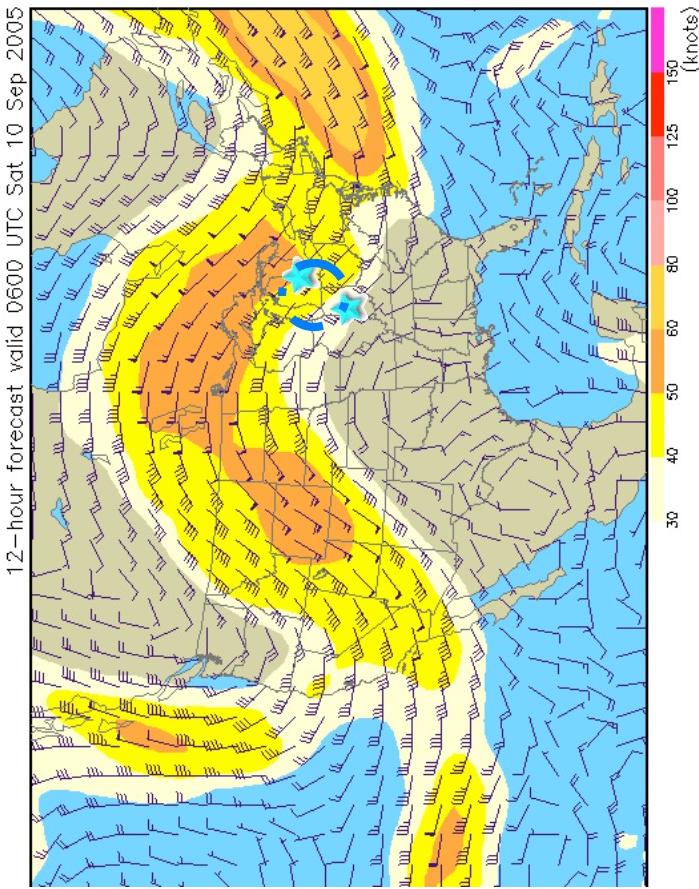
PIREP:

—28 090 Top of Clouds (FL)
—28 090 Flight Level (FL)
—28 090 Base of Clouds (FL)
—28 090 Temperature (C)
—28 090 Visibility (SM)
—28 090 Weather

Wind speed forecasts for the Indianapolis/Detroit leg of flight:

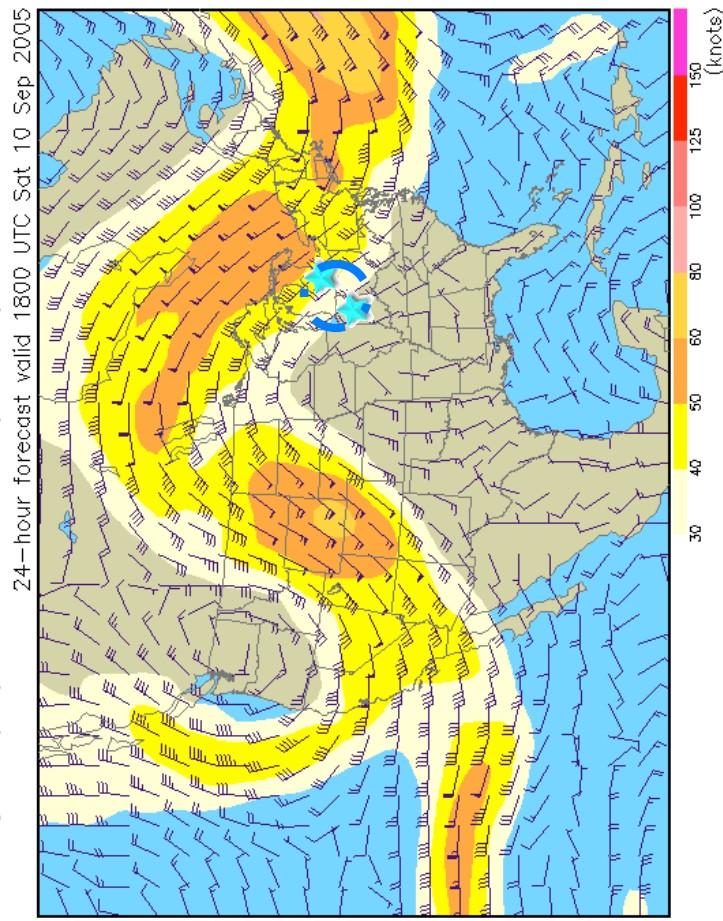
Begin data collection when arrive in Detroit, MI Orbit for 12 hours from 2230 UTC on 9 September 2005 to 1030 UTC on 10 September 2005.

Wind speed (kts) at 48,000 ft MSL (125 mb)

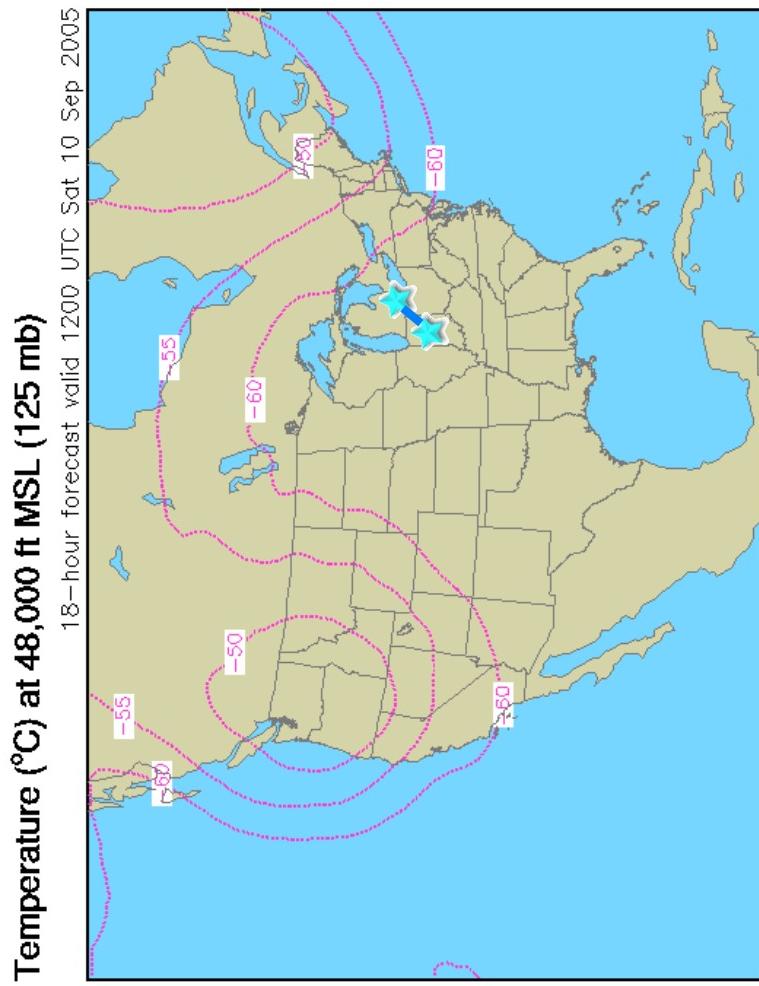


Winds for this portion of flight are approximately 30-40 knots from the northwest.

Wind speed (kts) at 48,000 ft MSL (125 mb)

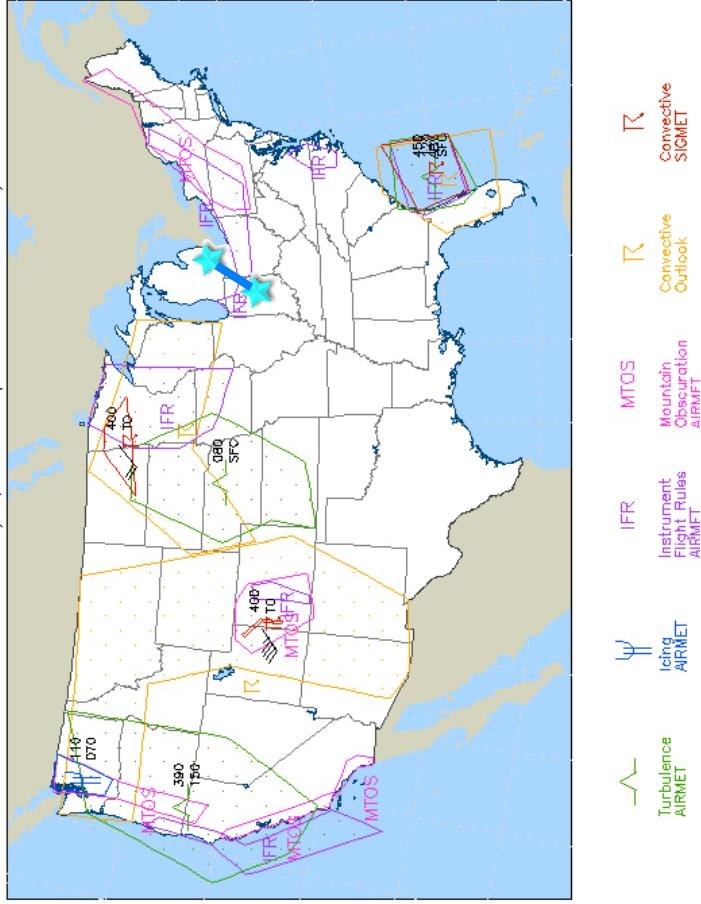


Temperature forecast for FL480 valid 1200 UTC on 10 September 2005.



Data collection in progress for Detroit/Indianapolis leg of flight.

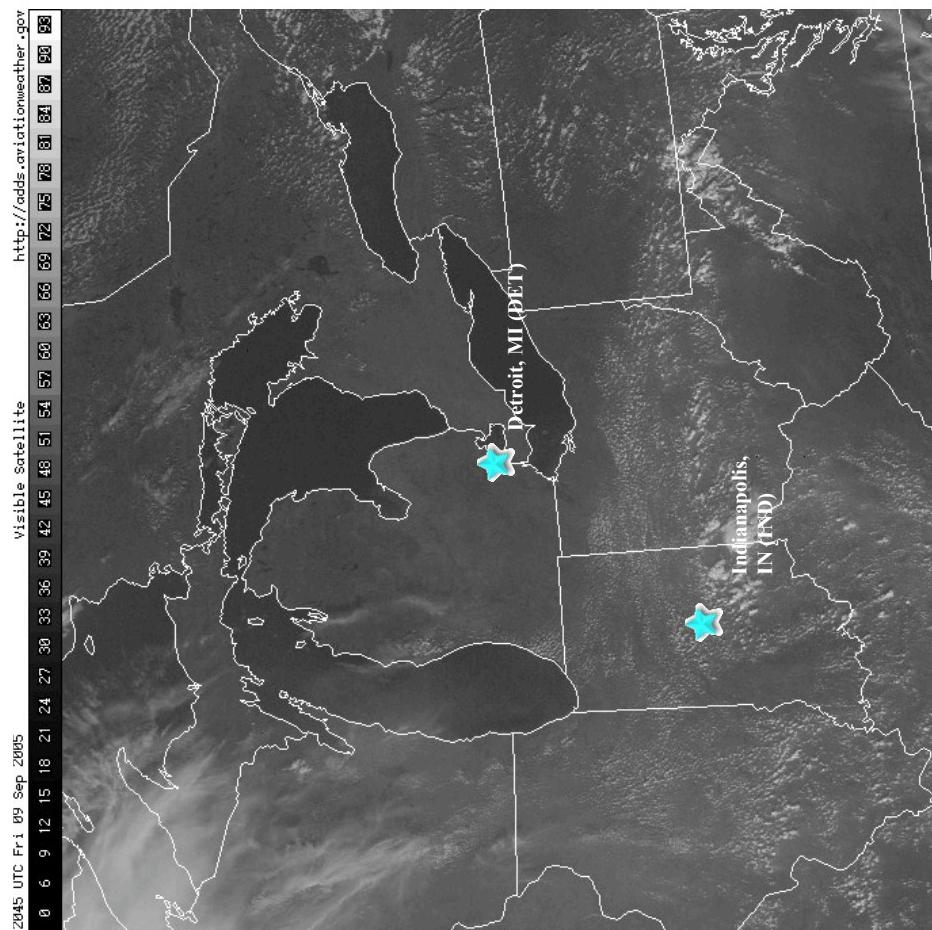
All active AIRMETs and SIGMETs
chart created at 1456 UTC Fri 09 Sep 2005
AIRMETs valid until 2000z/9th, SIGMETs expire at or before 1655z/9th



All active AIRMETs and SIGMETs
valid 1456 UTC on 9 September 2005.

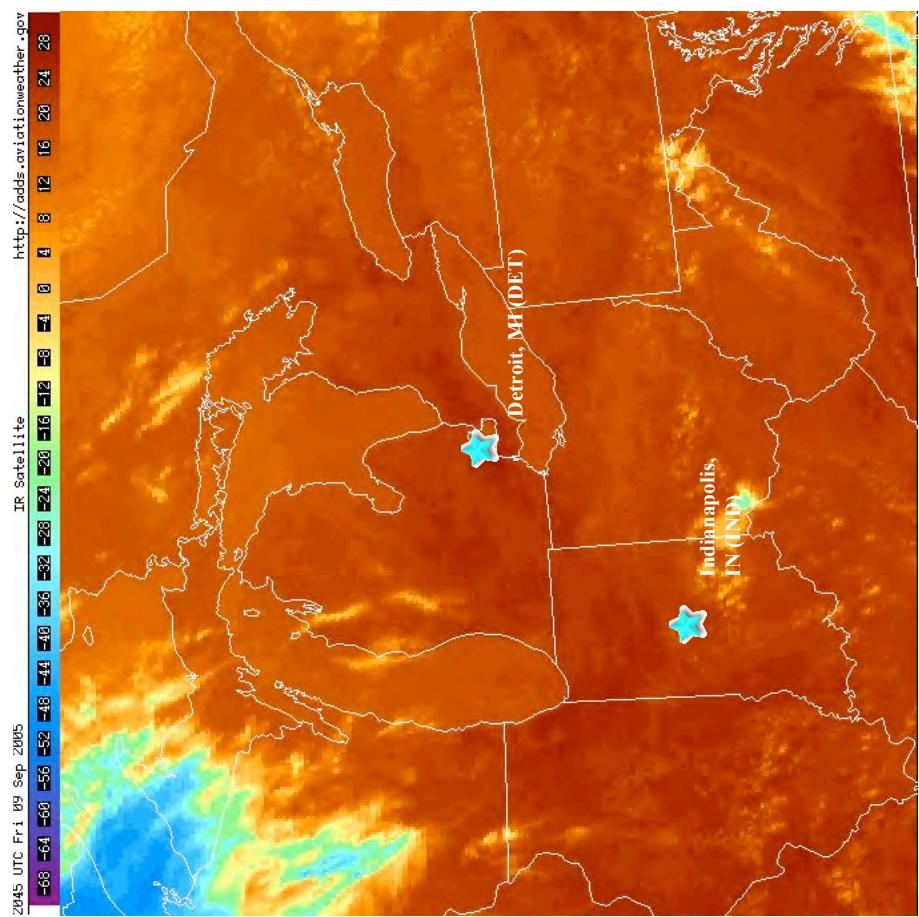
AIRMETs are valid until 2000 UTC
on 9 September 2005.

SIGMETs expire at 1655 UTC on 9
September 2005.

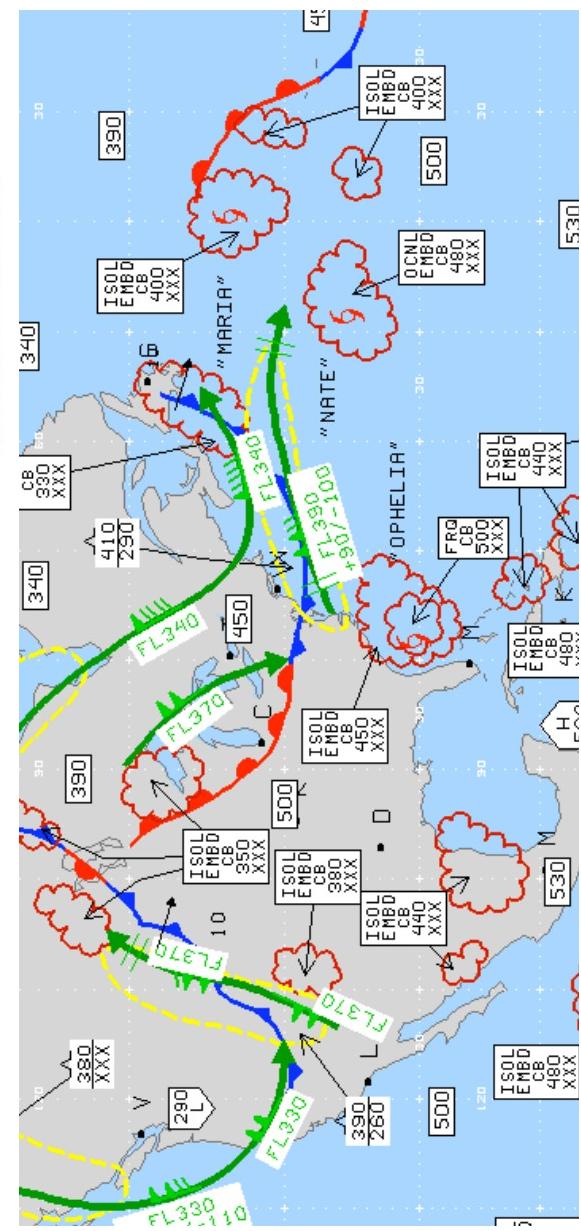
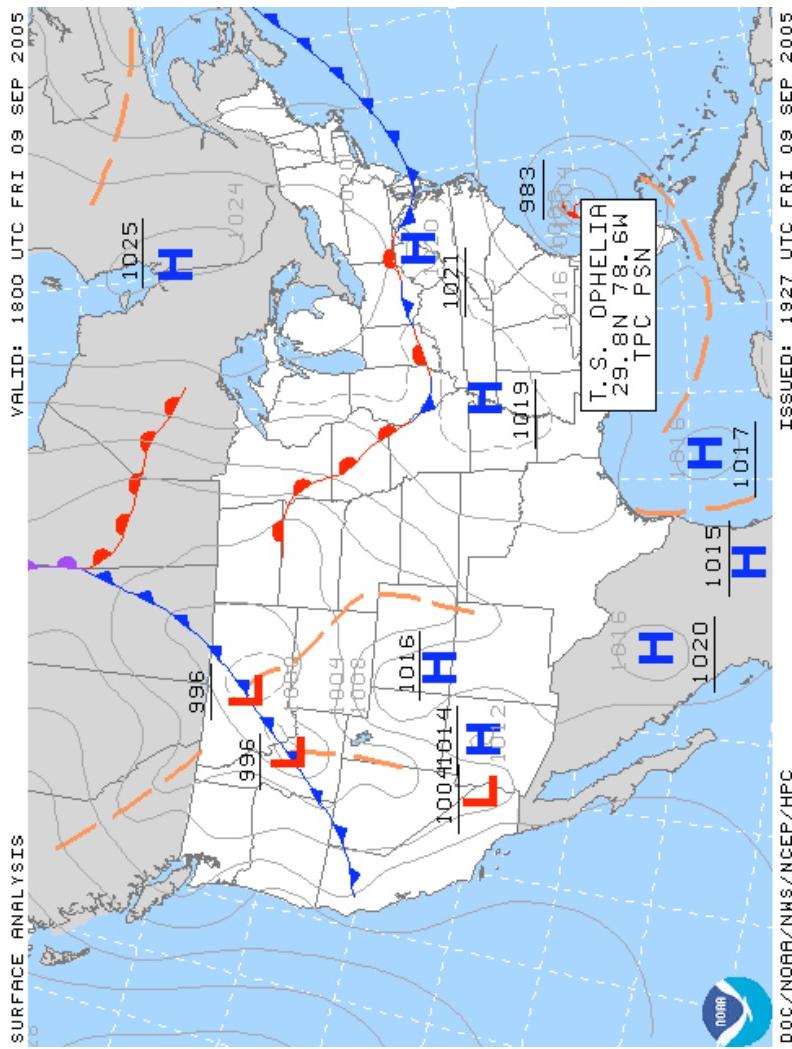


No significant weather for this area.

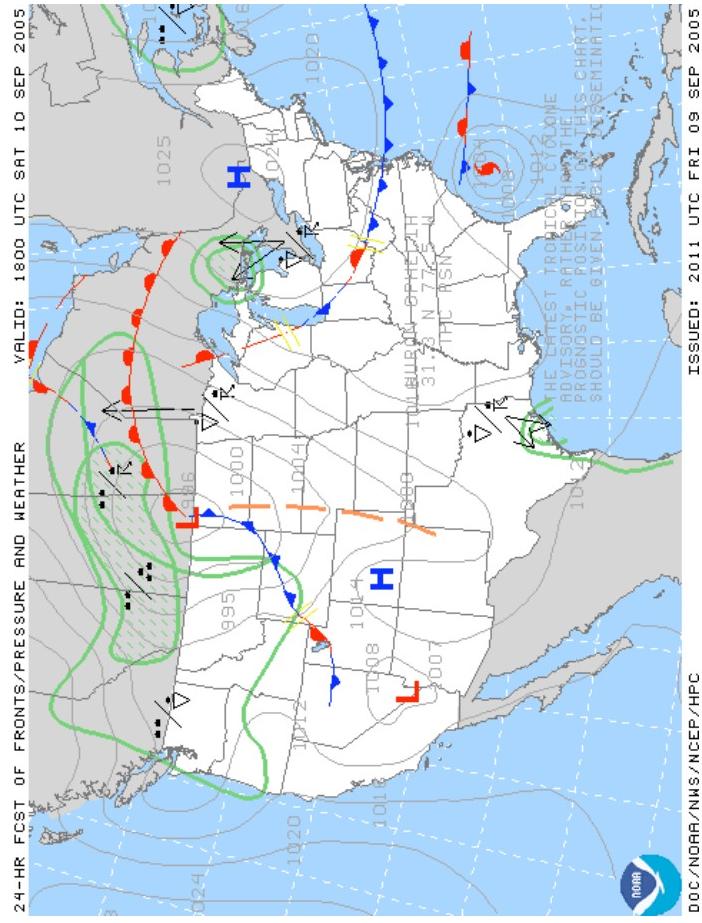
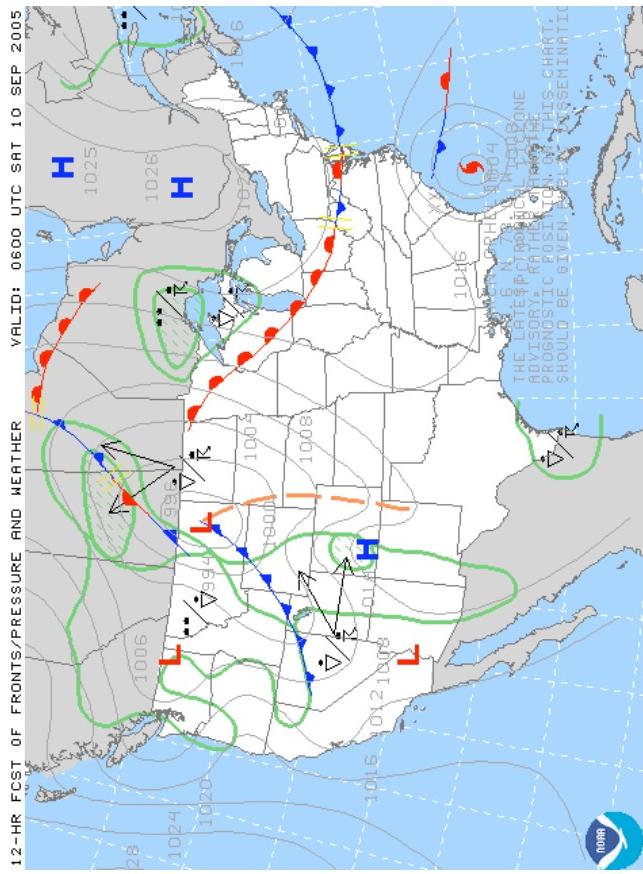
Visible and IR imagery for the Detroit/Indianapolis area:



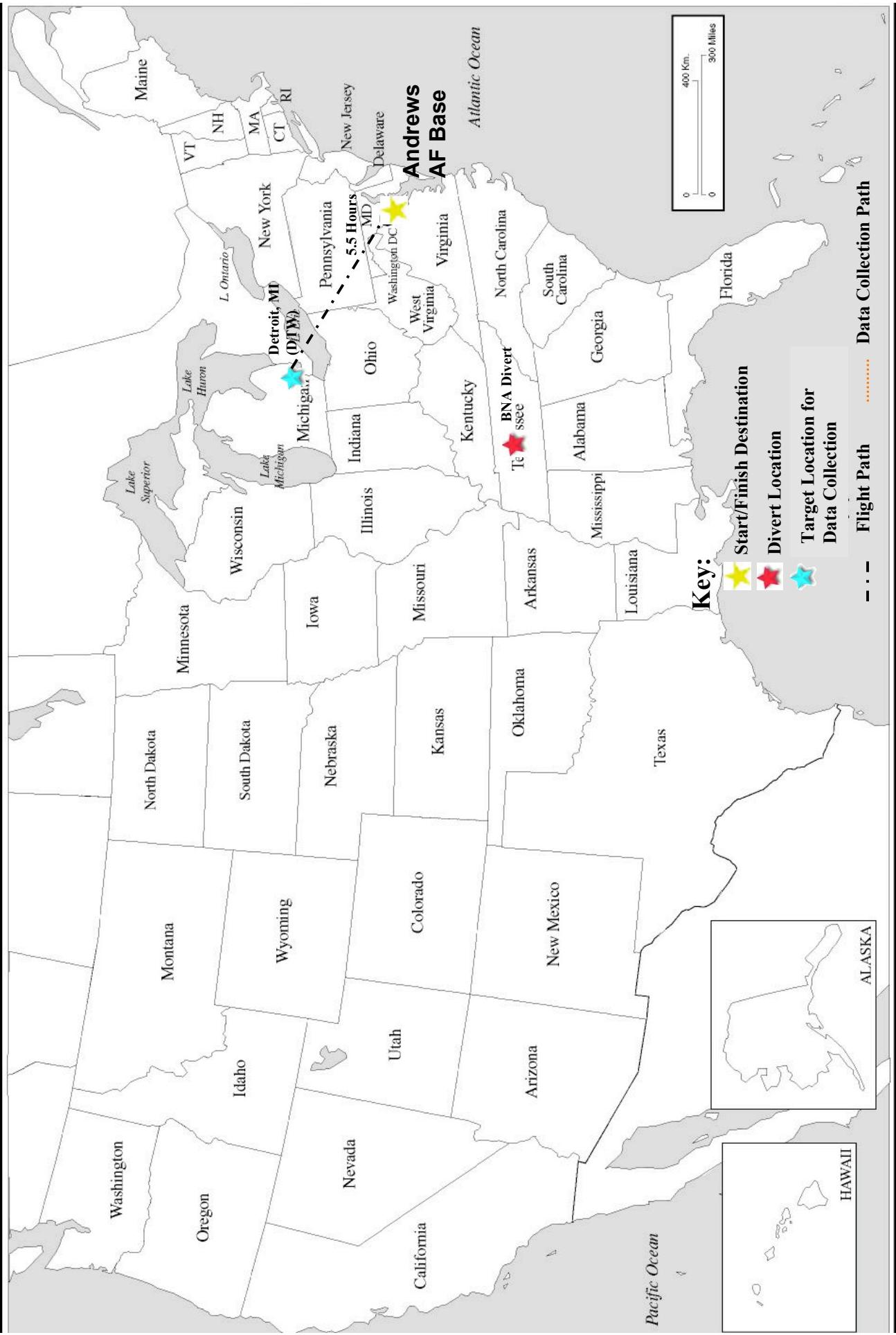
Surface map and high-level fixed time forecast for the continental U.S. during the IND/DET leg of flight:



12 hour and 24 hour surface level forecasts valid until 0600 UTC and 1800 UTC respectively on 10 September 2005.



Flight Scenario Final Leg

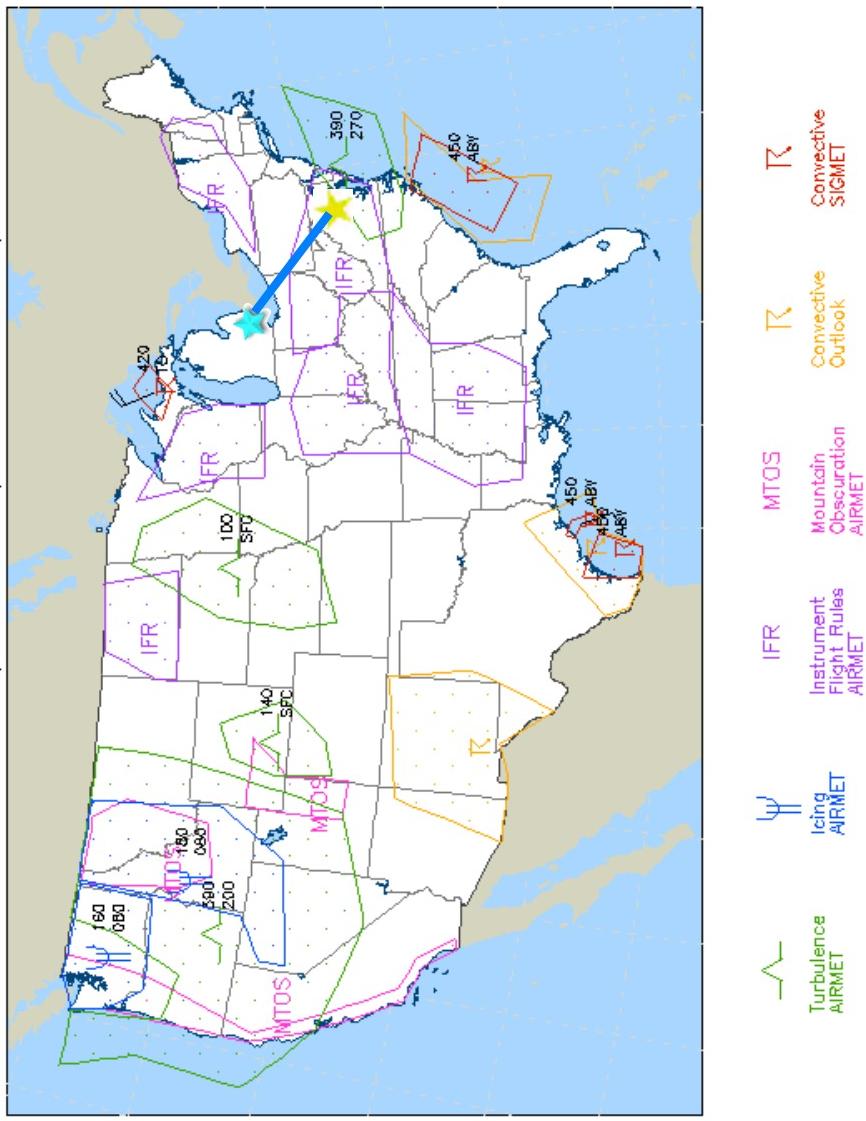


**Current Time: approximately 1500
UTC on 10 September 2005**

On Final approach from Detroit, MI to
Andrew's AFB.

All active AIRMETs and SIGMETs

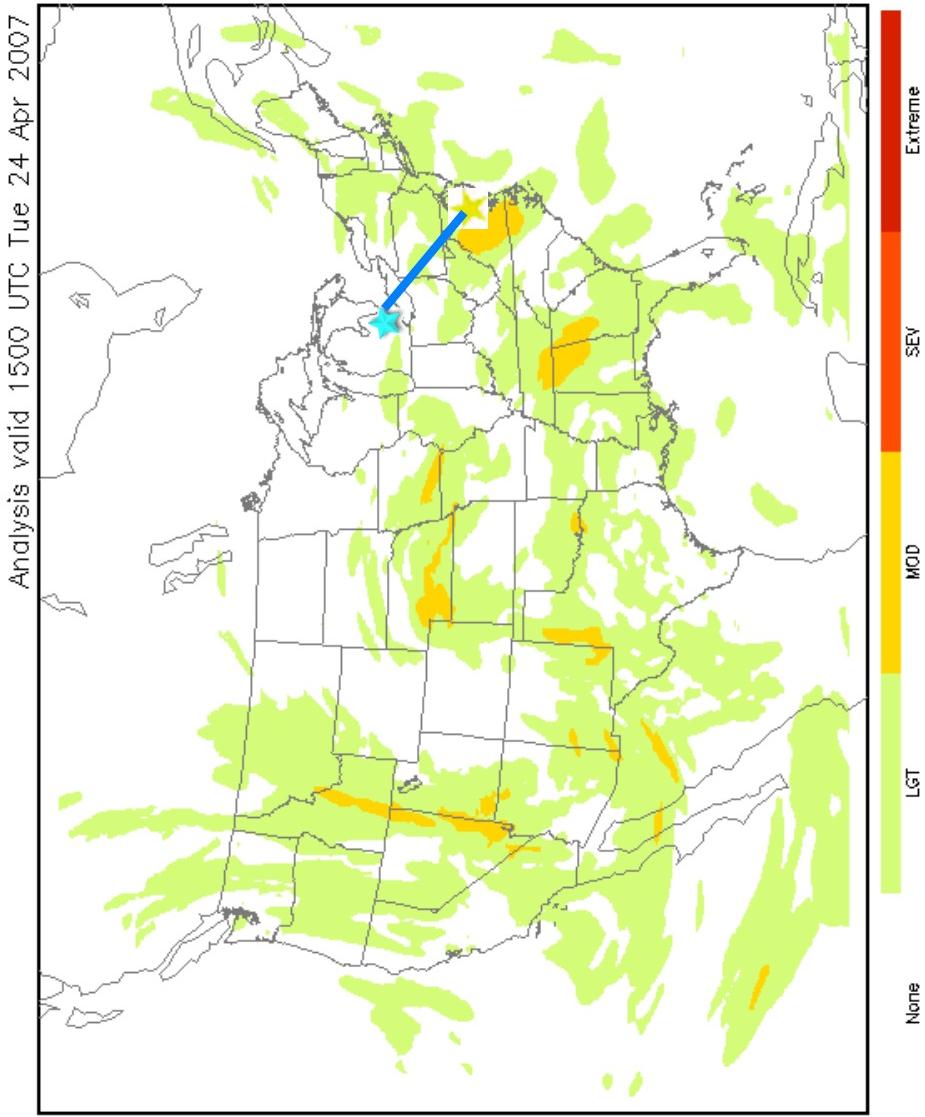
chart created at 1338 UTC Sat 10 Sep 2005
AIRMETs valid until 1400z/10th, SIGMETs expire at or before 1455z/10th



Turbulence forecast at FL450 valid
1200 UTC on 10 September 2005:

**Map shows light turbulence
or less enroute from
Detroit to Andrews AFB
with some areas of
moderate turbulence just
south of Andrews AFB.**

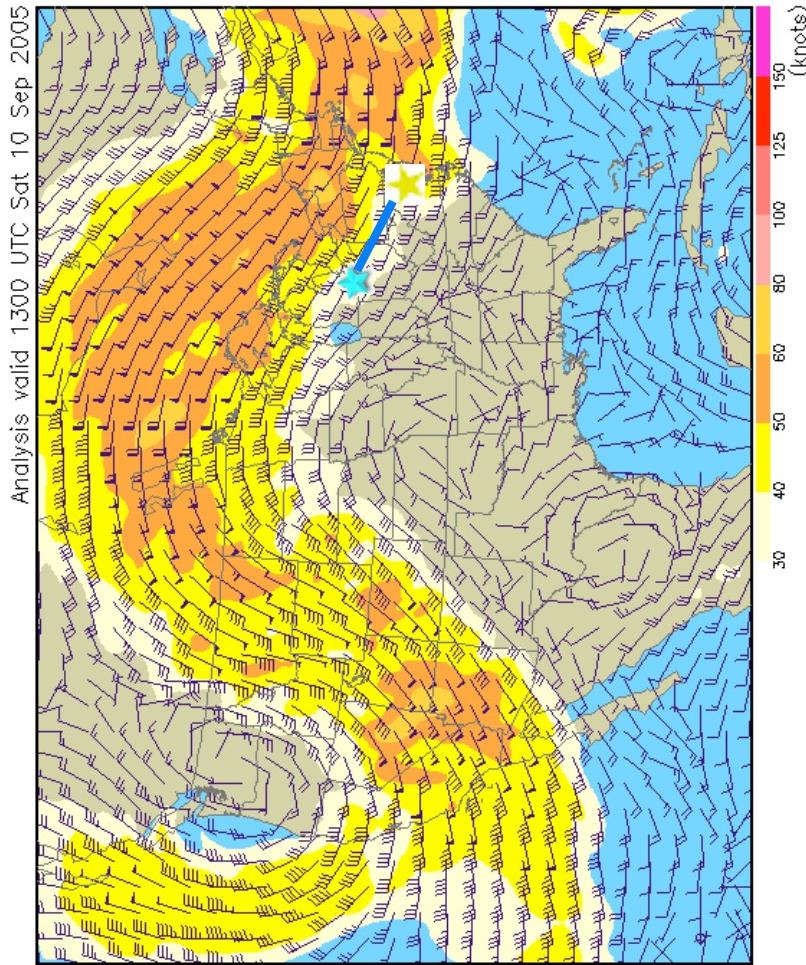
Turbulence forecast at FL450



Wind speeds at 1300 UTC on 10 September 2005 for FL480.

The plane will be flying in the jet stream from Detroit to Andrews AFB with winds around 30-40 knots.

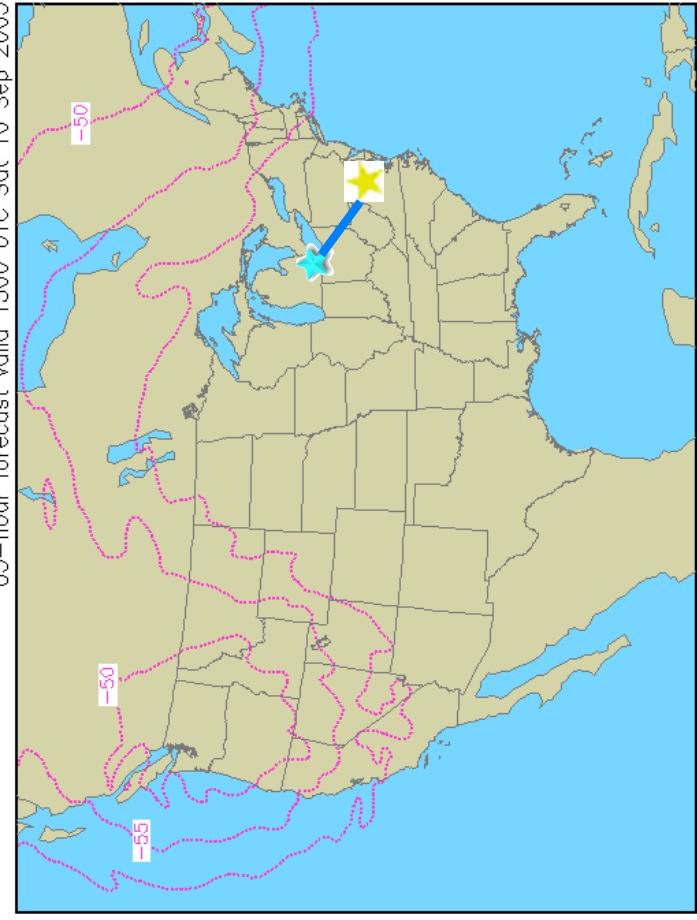
Wind speed (kts) at 48,000 ft MSL (125 mb)



Temperatures at FL480 valid 1500 UTC on 10 September 2005.

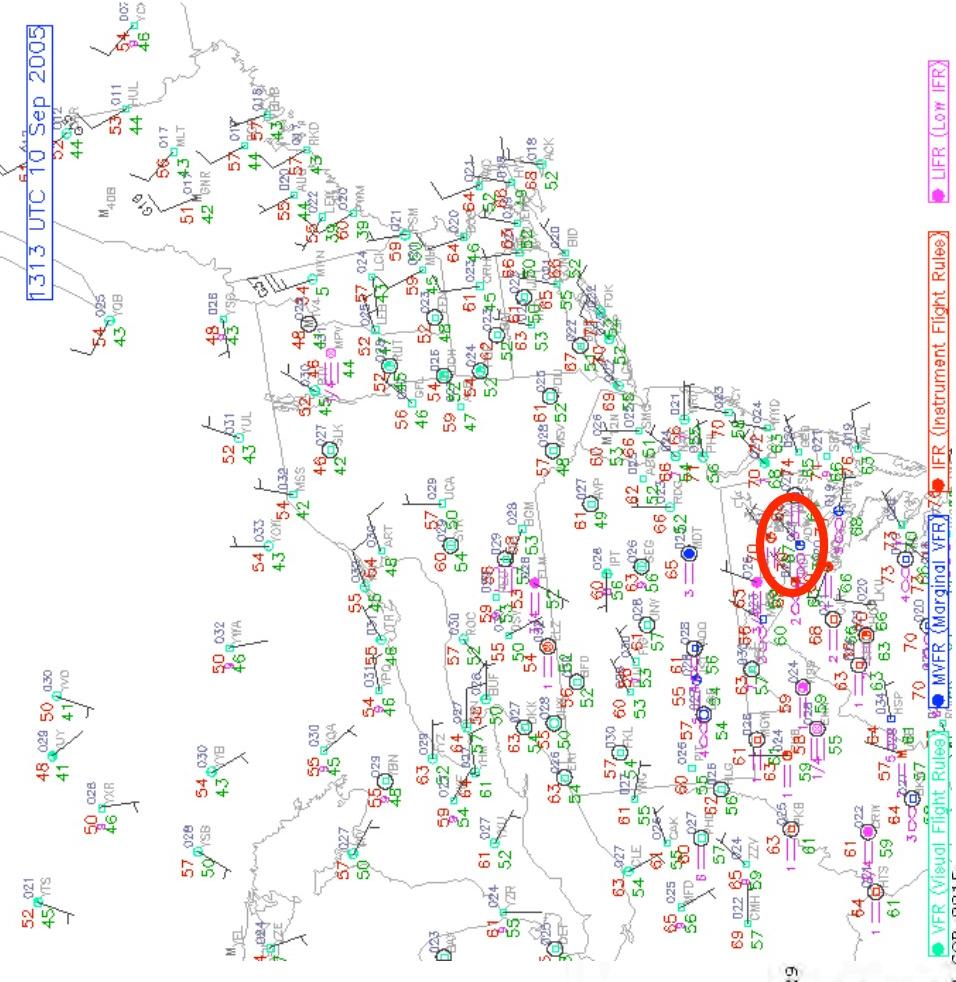
Temperatures at this time are approximately -60 degrees Celsius.

Temperature ($^{\circ}\text{C}$) at 48,000 ft MSL (125 mb)
0.3-hour forecast valid 1500 UTC Sat 10 Sep 2005



METAR for the Andrew's AFB and surrounding area at approximately 1313 UTC on 10 September 2005.

Broken clouds with ceiling at 030 for Andrews AFB. Winds from the east (080) at 6 kts.



• IFR (Low IFR)

• VFR (Marginal VFR)

• VFR (Instrument Flight Rules)

• VFR (Visual Flight Rules)

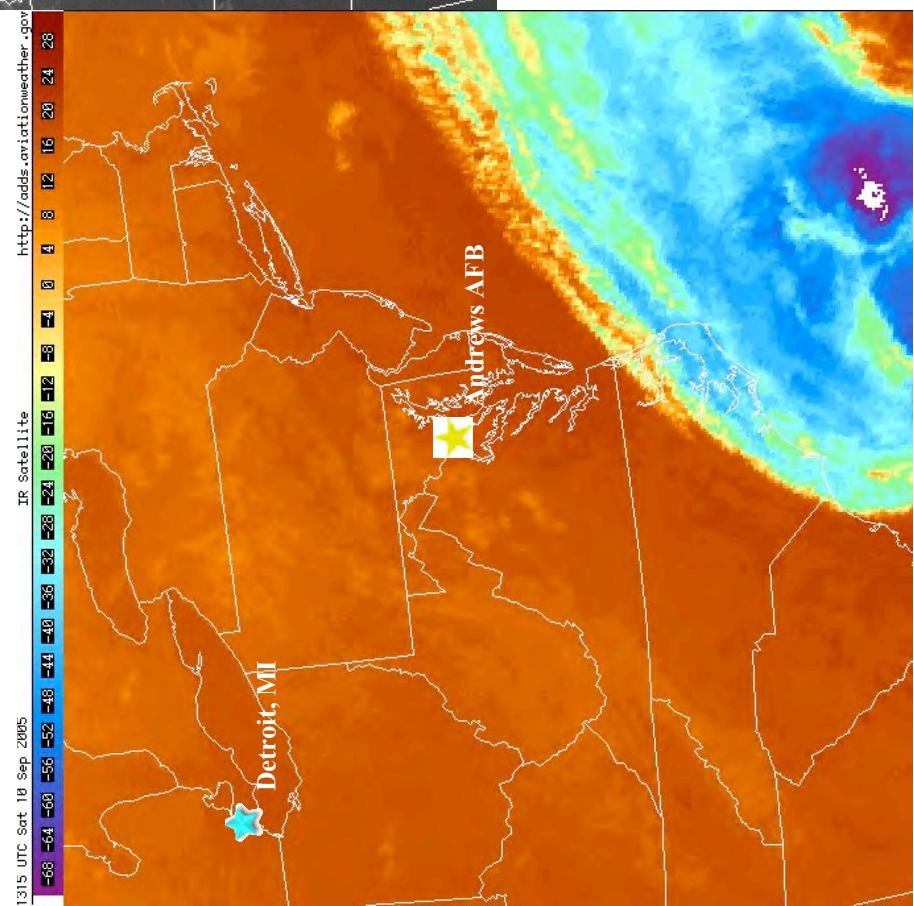
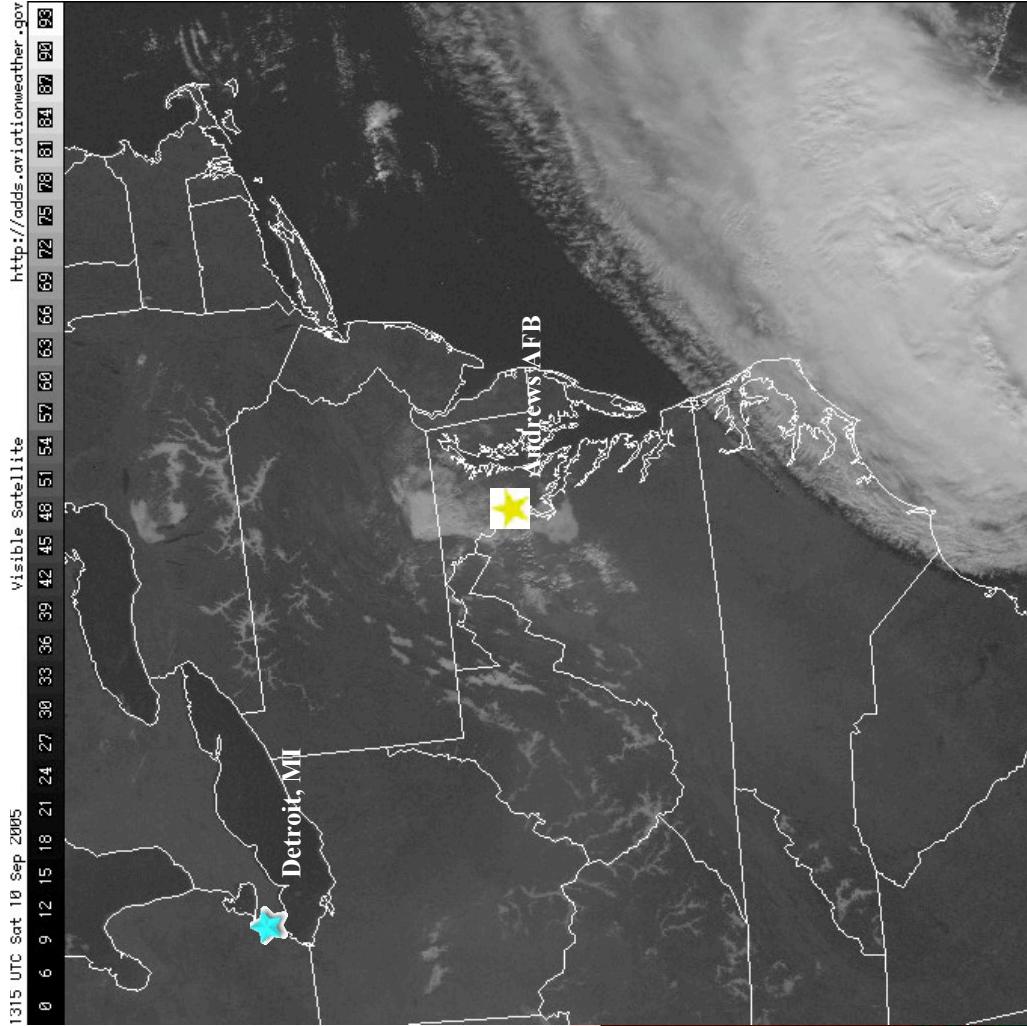
• MVFR

• SFC

• END

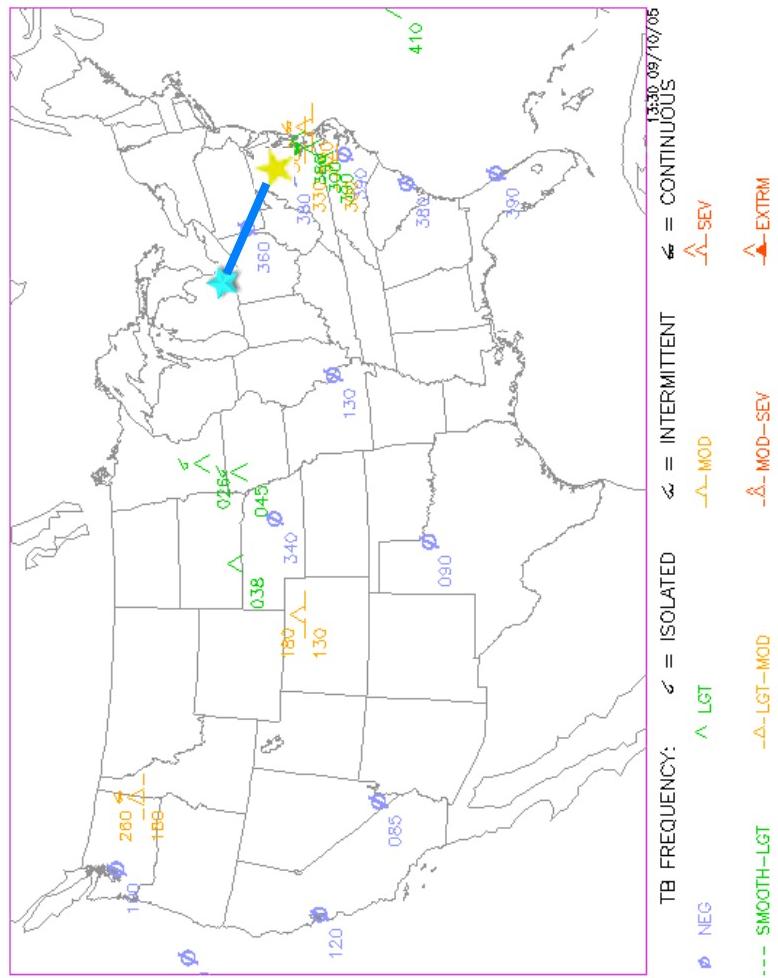
Visible Satellite Imagery of the route of flight from Detroit to Andrews AFB at 1315 UTC on 10 September 2005

Both images show a disturbance in the area off the Carolina coast. The pilot should be aware of this disturbance caused by Tropical Storm Ophelia in the Atlantic. Visible imagery indicates low clouds or fog in the area around Andrews AFB.



Infrared Imagery of the route of flight valid 1315 on 10 September 2005

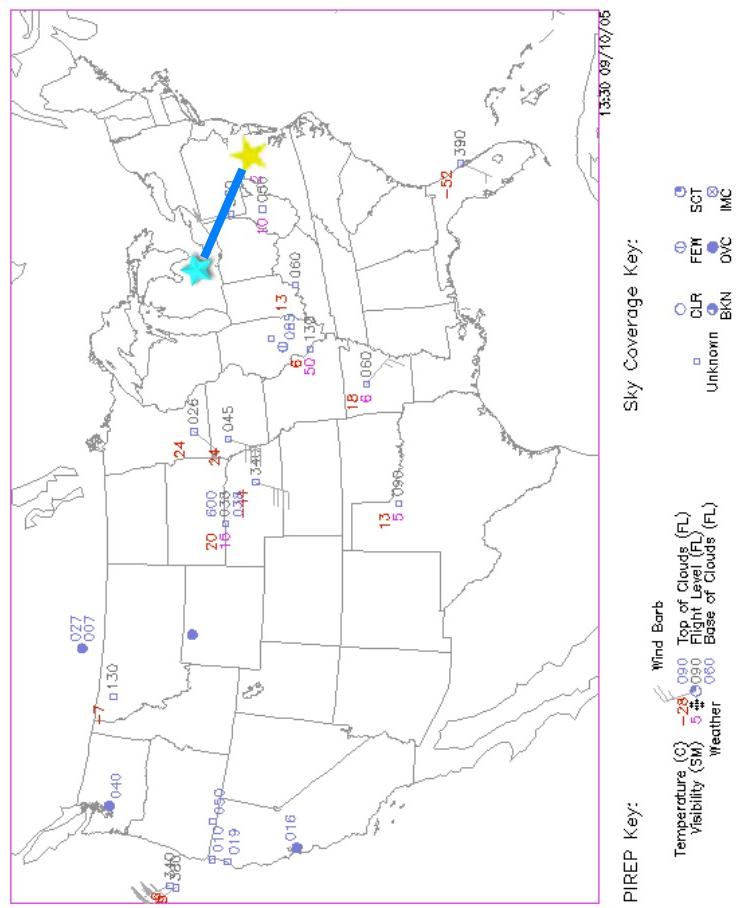
PIREPs of Turbulence and Weather and Sky conditions valid until 1330 on 10 September 2005:



The Pilot should be aware there is light to moderate turbulence in the Andrews AFB area.

Pilot Reports (PIREPs) of Weather and Sky Conditions

1158z – 1326z 09/10/05



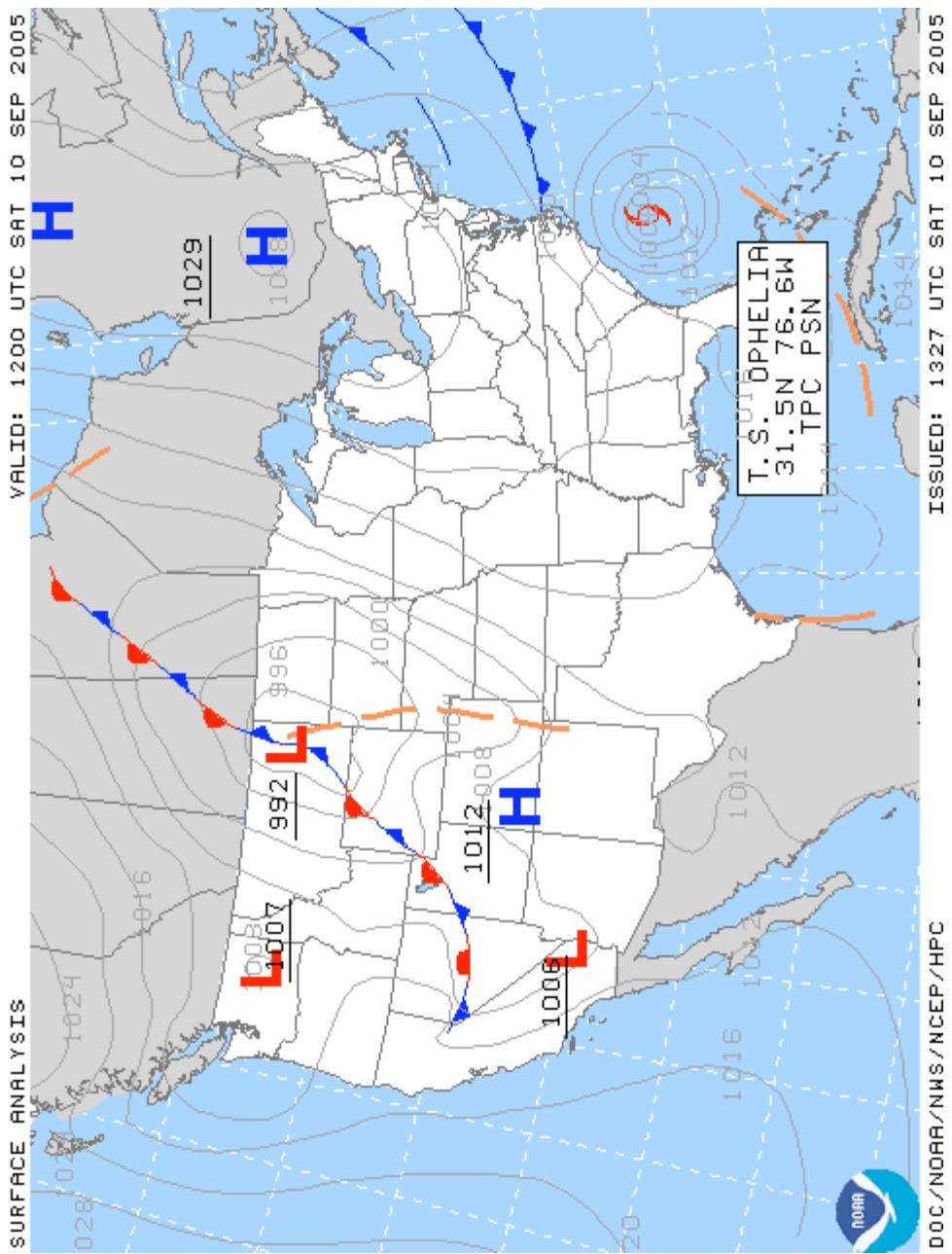
PIREP Key:

| | |
|----------------|-----------|
| Temperture (C) | Wind Barb |
| 230 | 000 |
| 240 | 000 |
| 250 | 000 |
| 260 | 000 |
| 270 | 000 |
| 280 | 000 |
| 290 | 000 |
| 300 | 000 |
| 310 | 000 |
| 320 | 000 |
| 330 | 000 |
| 340 | 000 |
| 350 | 000 |
| 360 | 000 |
| 370 | 000 |
| 380 | 000 |
| 390 | 000 |
| 400 | 000 |
| 410 | 000 |
| 420 | 000 |
| 430 | 000 |
| 440 | 000 |
| 450 | 000 |
| 460 | 000 |
| 470 | 000 |
| 480 | 000 |
| 490 | 000 |
| 500 | 000 |
| 510 | 000 |
| 520 | 000 |
| 530 | 000 |
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| 610 | 000 |
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| 660 | 000 |
| 670 | 000 |
| 680 | 000 |
| 690 | 000 |
| 700 | 000 |
| 710 | 000 |
| 720 | 000 |
| 730 | 000 |
| 740 | 000 |
| 750 | 000 |
| 760 | 000 |
| 770 | 000 |
| 780 | 000 |
| 790 | 000 |
| 800 | 000 |
| 810 | 000 |
| 820 | 000 |
| 830 | 000 |
| 840 | 000 |
| 850 | 000 |
| 860 | 000 |
| 870 | 000 |
| 880 | 000 |
| 890 | 000 |
| 900 | 000 |
| 910 | 000 |
| 920 | 000 |
| 930 | 000 |
| 940 | 000 |
| 950 | 000 |
| 960 | 000 |
| 970 | 000 |
| 980 | 000 |
| 990 | 000 |
| 1000 | 000 |
| 1010 | 000 |
| 1020 | 000 |
| 1030 | 000 |
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| 1050 | 000 |
| 1060 | 000 |
| 1070 | 000 |
| 1080 | 000 |
| 1090 | 000 |
| 1100 | 000 |
| 1110 | 000 |
| 1120 | 000 |
| 1130 | 000 |
| 1140 | 000 |
| 1150 | 000 |
| 1160 | 000 |
| 1170 | 000 |
| 1180 | 000 |
| 1190 | 000 |
| 1200 | 000 |
| 1210 | 000 |
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| 1240 | 000 |
| 1250 | 000 |
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| 1280 | 000 |
| 1290 | 000 |
| 1300 | 000 |
| 1310 | 000 |
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| 1350 | 000 |
| 1360 | 000 |
| 1370 | 000 |
| 1380 | 000 |
| 1390 | 000 |
| 1400 | 000 |
| 1410 | 000 |
| 1420 | 000 |
| 1430 | 000 |
| 1440 | 000 |
| 1450 | 000 |
| 1460 | 000 |
| 1470 | 000 |
| 1480 | 000 |
| 1490 | 000 |
| 1500 | 000 |
| 1510 | 000 |
| 1520 | 000 |
| 1530 | 000 |
| 1540 | 000 |
| 1550 | 000 |
| 1560 | 000 |
| 1570 | 000 |
| 1580 | 000 |
| 1590 | 000 |
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| 1630 | 000 |
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| 1660 | 000 |
| 1670 | 000 |
| 1680 | 000 |
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| 1700 | 000 |
| 1710 | 000 |
| 1720 | 000 |
| 1730 | 000 |
| 1740 | 000 |
| 1750 | 000 |
| 1760 | 000 |
| 1770 | 000 |
| 1780 | 000 |
| 1790 | 000 |
| 1800 | 000 |
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| 1880 | 000 |
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| 1970 | 000 |
| 1980 | 000 |
| 1990 | 000 |
| 2000 | 000 |
| 2010 | 000 |
| 2020 | 000 |
| 2030 | 000 |
| 2040 | 000 |
| 2050 | 000 |
| 2060 | 000 |
| 2070 | 000 |
| 2080 | 000 |
| 2090 | 000 |
| 2100 | 000 |
| 2110 | 000 |
| 2120 | 000 |
| 2130 | 000 |
| 2140 | 000 |
| 2150 | 000 |
| 2160 | 000 |
| 2170 | 000 |
| 2180 | 000 |
| 2190 | 000 |
| 2200 | 000 |
| 2210 | 000 |
| 2220 | 000 |
| 2230 | 000 |
| 2240 | 000 |
| 2250 | 000 |
| 2260 | 000 |
| 2270 | 000 |
| 2280 | 000 |
| 2290 | 000 |
| 2300 | 000 |
| 2310 | 000 |
| 2320 | 000 |
| 2330 | 000 |
| 2340 | 000 |

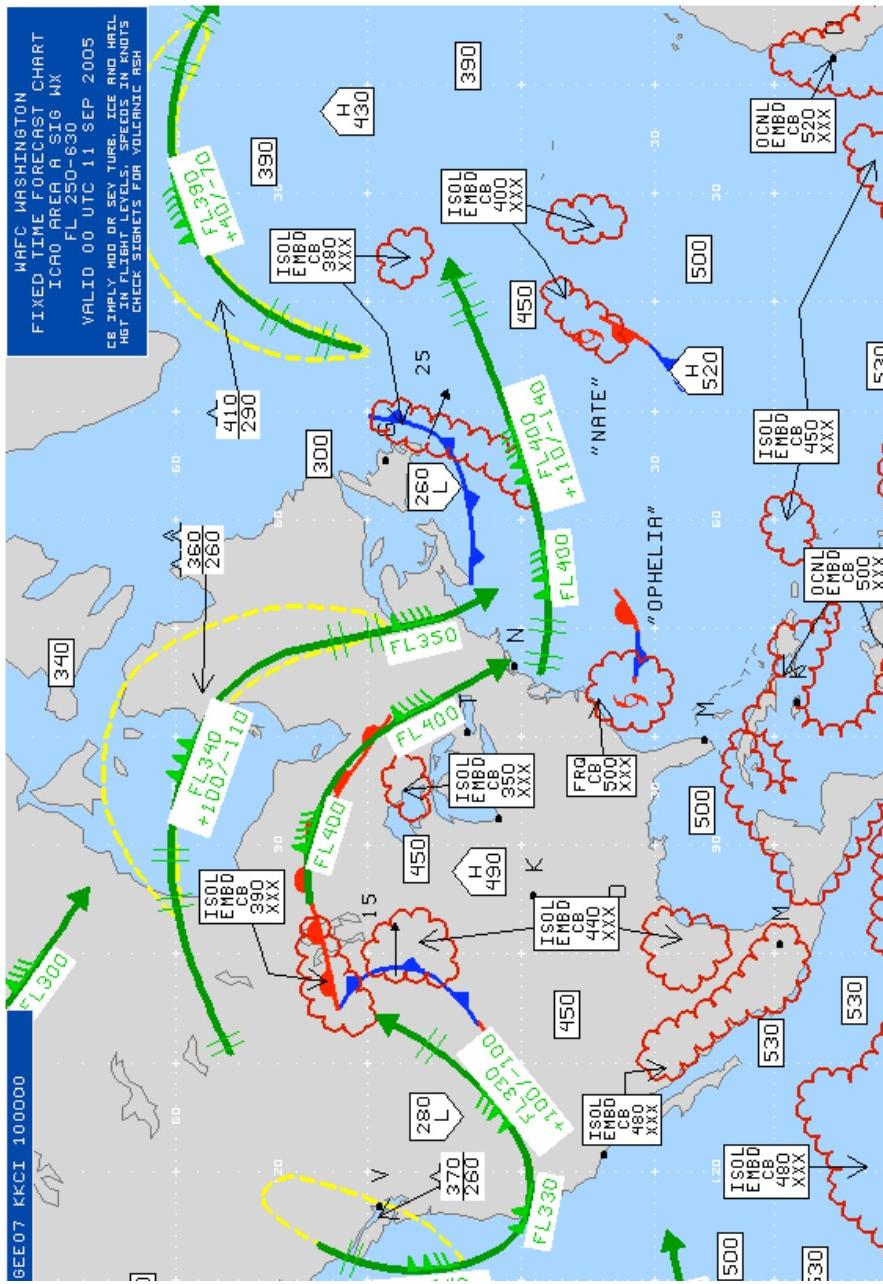
Surface analysis valid 1200 UTC on 10 September 2005.

Map shows important divert/contingency management information for this leg of flight.

Map also shows the current location of Tropical Storm Ophelia.



High-level fixed time forecast weather data valid until 0000 UTC on 11 September 2005.



Reminder: Our Mission Objectives

The objectives of this mission are as follows:

- To depict the necessary weather data that must be accessible via a QICP weather provider to UAV pilots in order to conduct safe and successful missions
- To explain the knowledge that must be extrapolated from the weather data sources
- To show the complexity of forecasting weather for HALLE missions
- To show potential contingency scenarios that may result from emergency situations
- To show the importance of weather to the overall success of the mission.

End of Flight Scenario

Any Questions??

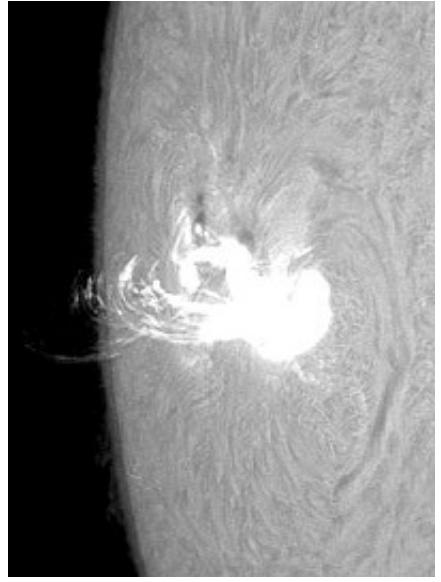


Contingency Scenario 0

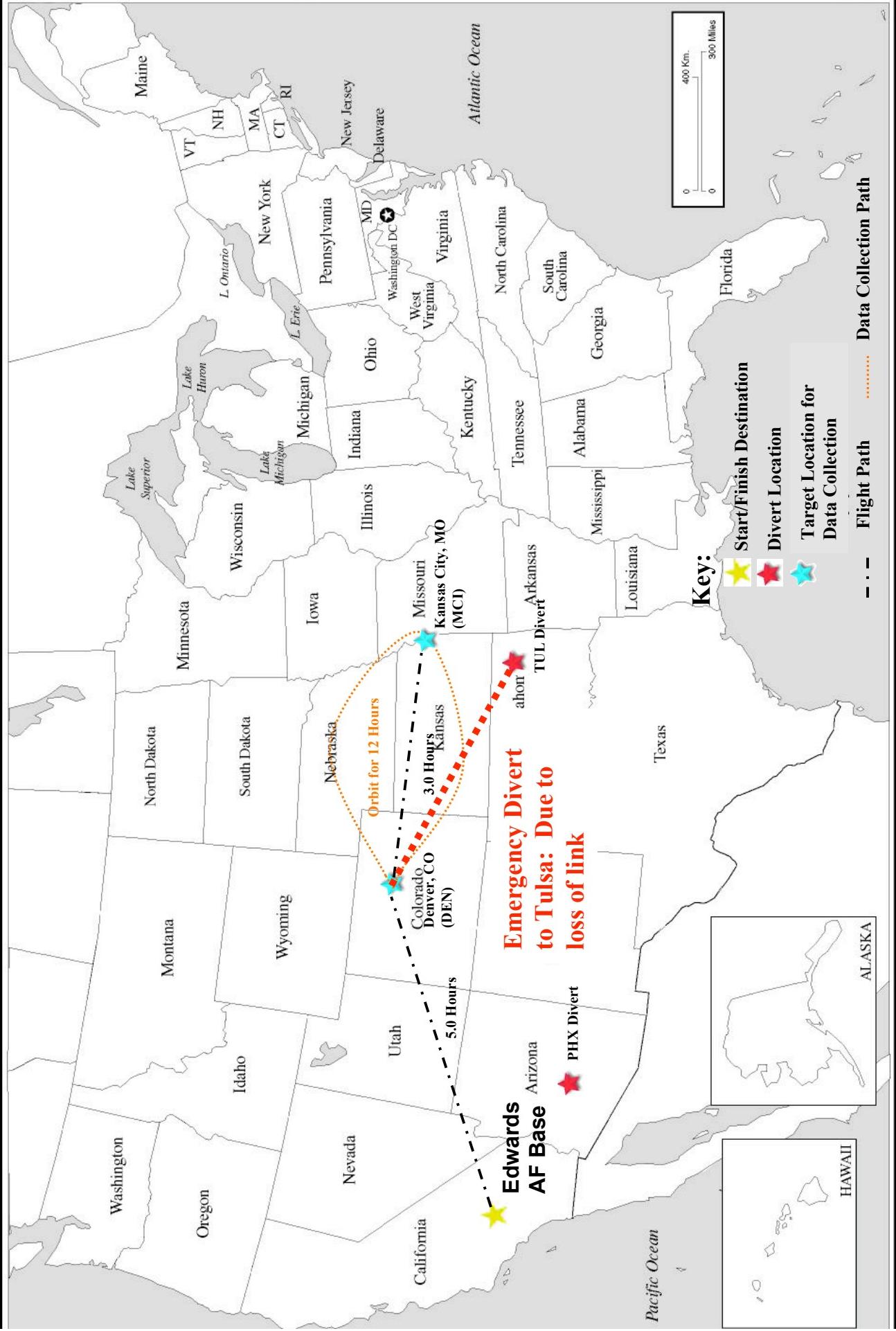


Solar Weather Causes Loss of Link during Orbit One

- On September 7th, sunspot # 798/808 exploded, producing an X-17 solar flare. Explosions are expected to continue for the next few days.
- Each X-flare causes a shortwave radio blackout on Earth and pumped new energy into a radiation storm around our planet.
- Magnetic clouds are scheduled to hit the Earth on September 10th causing aurora's that are being seen as far south as Arizona.
- This solar activity has cause a loss of link on our UAV mid-orbit. The pilot should be aware of this activity and the plane is recommended to divert to the nearest divert point—in this section of flight the divert location is Tulsa, OK.
- In addition to solar activity, the METAR shows thunderstorms evolving in the Denver area accompanied with lightning.

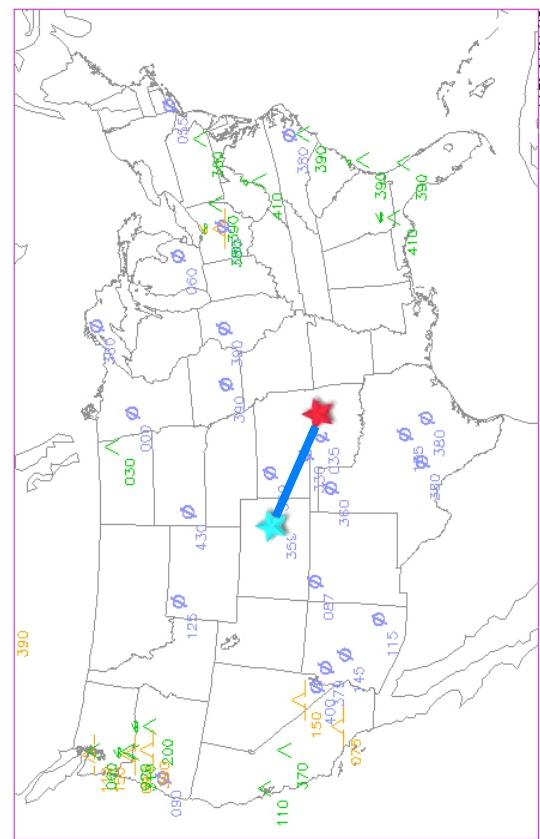


Access 5 Step One Flight Scenario Route



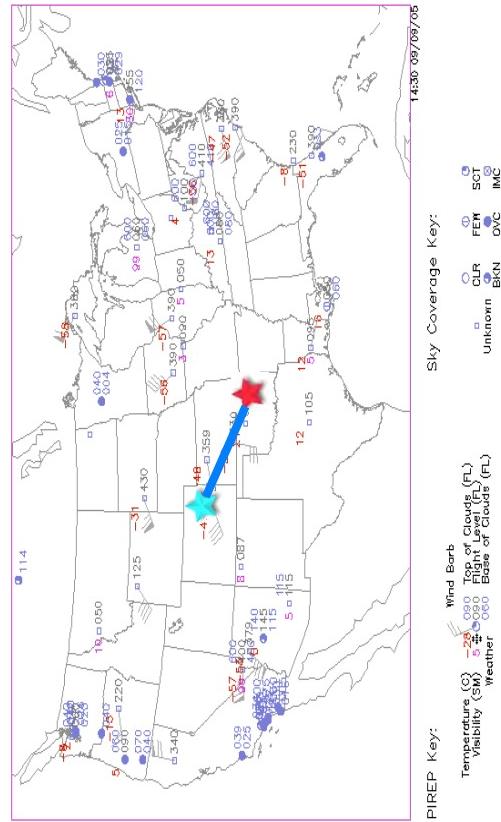
Surface Analysis and UA Charts for divert to Tulsa, OK valid 1200 UTC on 9 September 2005

Pilot Reports (PIREPs) of Turbulence
1259z – 1425z 09/09/05

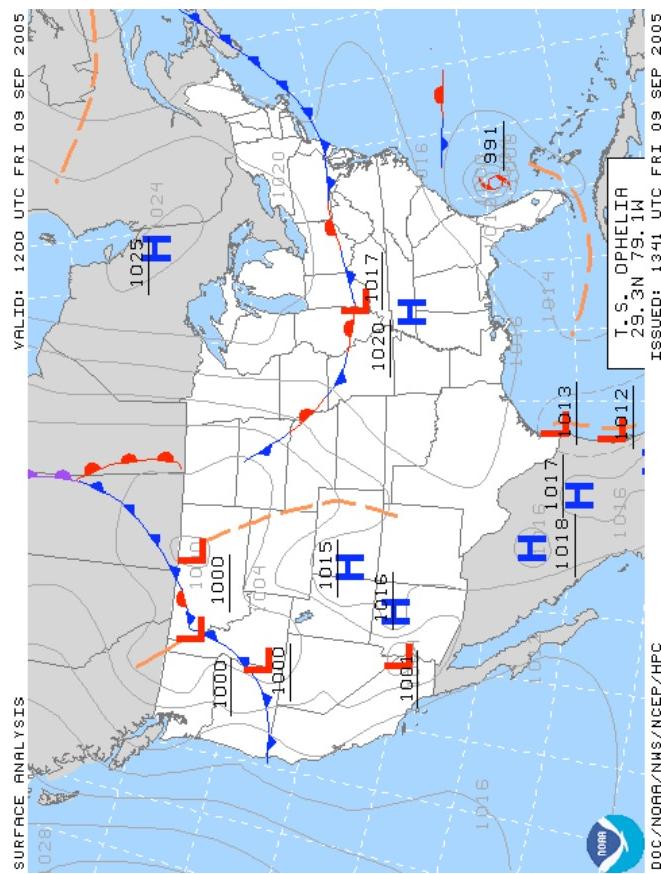
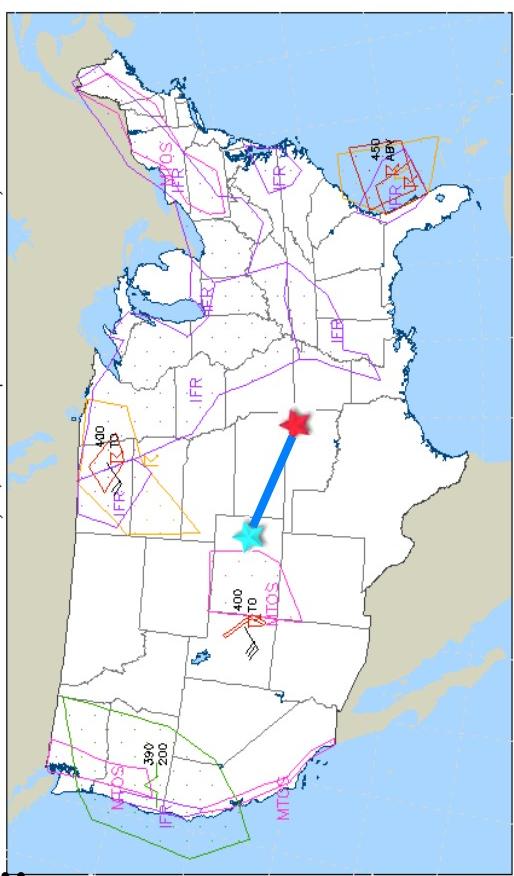


TB FREQUENCY: \triangleleft = ISOLATED \triangleleft = INTERMITTENT \triangleleft = CONTINUOUS
 \diamond NEG \triangle LGT $- \triangle$ LGT-MOD $- \triangle$ MOD-SEV $- \triangle$ EXTRM
 $- -$ SMOOTH-LGT

Pilot Reports (PIREPs) of Weather and Sky Conditions
1259z – 1425z 09/09/05



All active AIRMETS and SIGMETs
chart created at 1255 UTC Fri 09 Sep 2005
AIRMETs valid until 1400z/9th, SIGMETs expire at or before 1455z/9th

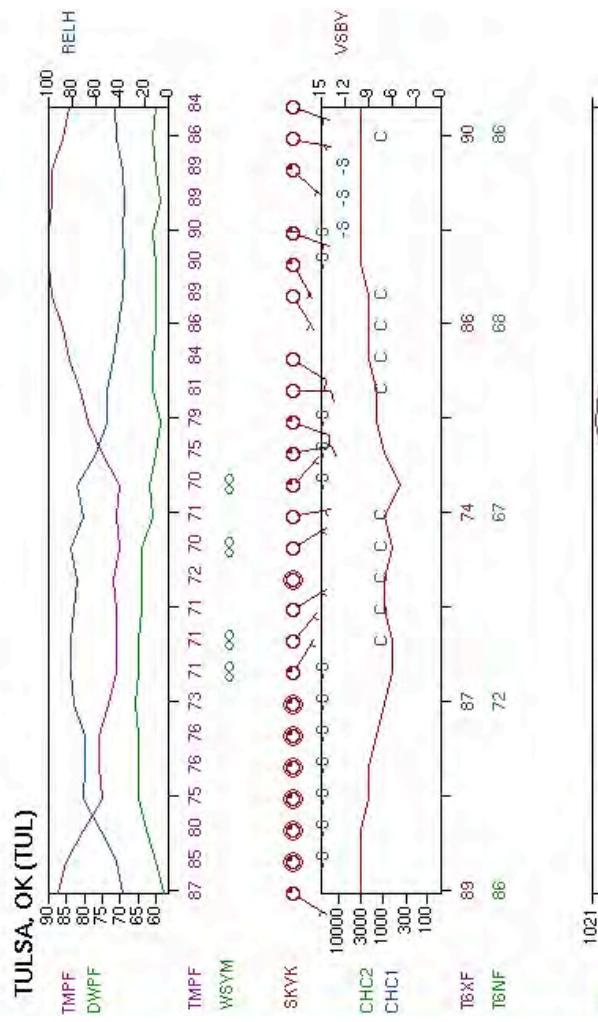


DOC/NOPR/NWS/NCEP/HPC
ISSUED: 1341 UTC FRI 09 SEP 2005

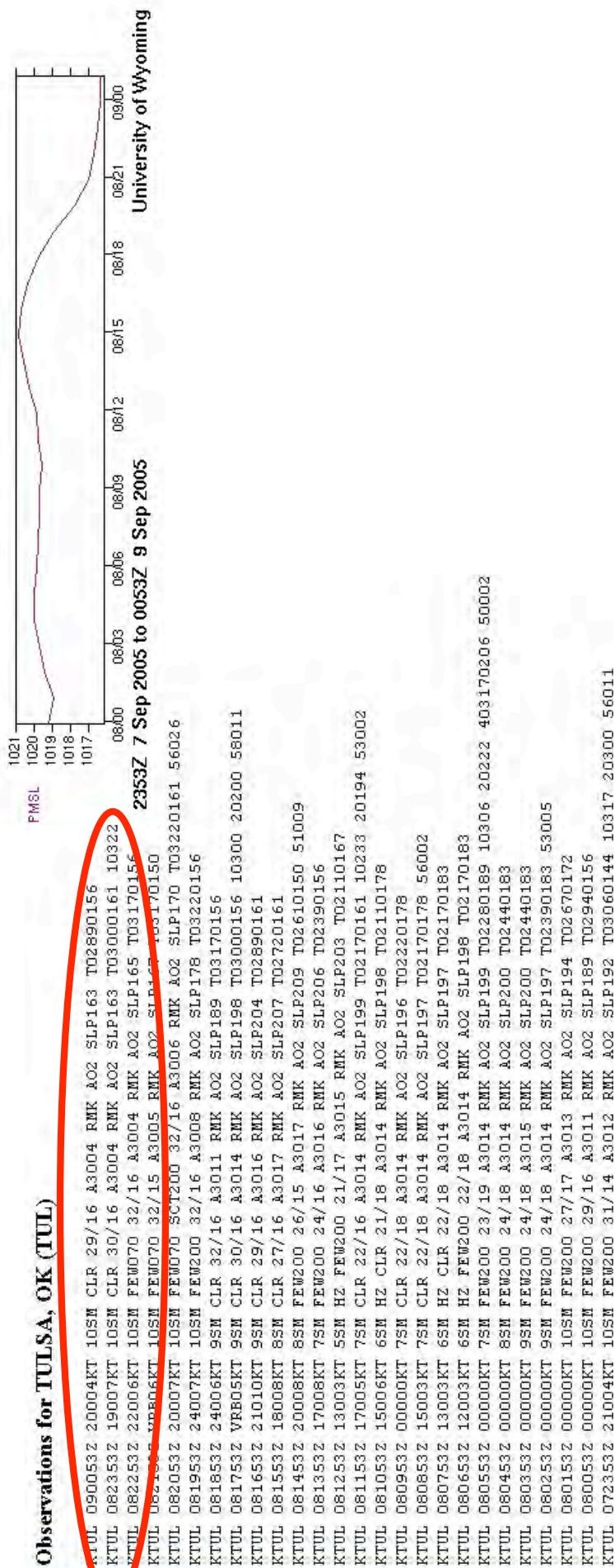
Divert to Tulsa, OK:

Observations for TULSA, OK (TUL)

2353Z 7 Sep 2005 to 0053Z 9 Sep 2005



Observations for TIII SA (OK (TII))



| | |
|--|--|
| Forecast for: | KTUL |
| Text: | KTUL 231727Z 231818 18007KT P6SM SCT250 |
| Forecast period: | 1800 UTC 23 September 2005 to 0400 UTC 24 September 2005 |
| Forecast type: | FROM: standard forecast or significant change |
| Winds: | from the S (180 degrees) at 8 MPH (7 knots; 3.6 m/s) |
| Visibility: | 6 miles (10 km) |
| Clouds: | scattered clouds at 25000 feet AGL |
| Weather: | no significant weather forecast for this period |
| TAF for Tulsa, Oklahoma | |
| NOTE: Specific TAFs related to the contingency scenario were not included in the original presentation. TAFs were included here to verify availability over the public internet Aviation Digital Data Service (ADD\$) site. | |
| TAF for Andrews Air Force Base | |
| Forecast for: | KADW |
| Text: | KADW 231717 34012KT 9999 SCT100 SCT250 QNH2994INS |
| Forecast period: | 1700 to 2000 UTC 23 September 2005 |
| Forecast type: | FROM: standard forecast or significant change |
| Winds: | from the NNW (340 degrees) at 14 MPH (12 knots; 6.2 m/s) |
| Visibility: | 6 or more miles (10+ km) |
| Clouds: | scattered clouds at 10000 feet AGL scattered clouds at 25000 feet AGL |
| Weather: | no significant weather forecast for this period |